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ABSTRACTS

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"ABSTRACTS of recent published material on Soil and Water Conservation" is prepared in the Soil and Water Conservation Research Division of the Agricultural Research Service.

They are issued at irregular intervals, and their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses have been appended to abstract.

This abstract represents the transition from the abstracting done by J. H. Stallings to that done by Charles B. Crook. In this abstract he has concentrated on bringing up to date the abstracts of those regularly published journals particularly applicable to soil and water conservation. They are as follows: Soil Science Society of America Proceedings; Journal of Range Management; American Geophysical Union-Transactions; Soil Science; Agronomy Journal; Agricultural Engineering; Journal of Soil and Water Conservation; and Journal of Forestry.

This is the SEVENTEENTH publication issued under this title. Previous issues were published as follows:

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8.	USDA	PA-228,	July	1953*
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10.	USDA	ARS-41-3,	August	1955*
11.	USDA	ARS-41-5,	December	1955*
12.	USDA	ARS-41-8,	July	1956
13.	USDA	ARS-41-17,	July	1957*
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SOIL SCIENCE (BASIC)

Soil Physics

Laws, W. Derby. RETENTION OF ORGANIC MATTER AND NITROGEN BY THE SILT AND CLAY FRACTIONS AND BY THE WHOLE SOIL AS Affected BY LIME AND ORGANIC RESIDUES. *Soil Sci. Soc. Amer. Proc.* 22: 9-12, 1958.

The experiment was conducted in glazed 3-gallon pots in the greenhouse, using Kirvin clay soil, limed and not limed, treated with red clover, wheat straw, and Juniper wood residues. An application of 59.5 mg. of nitrogen per 100 g. of soil was made at the beginning, and again after 15 months. Soil samples were taken from each treatment before planting the first crop, after 15 months, and again after 48 months. Ten crops were grown during the 4-year period.

There was a marked loss of nitrogen from all soils during the experiment, but loss from limed soil was greater than from unlimed soil. The highly carbonaceous materials retarded nitrogen loss. There was a tendency for nitrogen to accumulate in the silt fraction, especially in unlimed soil.

The amount of organic matter retained by the soil was not affected by lime content and there was no difference in organic matter and total nitrogen contents of the wheat straw and red clover treatments after 48 months, although the organic matter/nitrogen ratio was 21.0 for the red clover treatment and 34.4 for the wheat straw treatment when the experiment started.

Only the Juniper wood had a significant effect on aggregate stability after 48 months.

Charts and graphs

Agr. Lab., Tex. Res. Found., Renner, Tex.

Wittmuss, H. D., and Mazurak, A. P. PHYSICAL AND CHEMICAL PROPERTIES OF SOIL AGGREGATES IN A BRUNIZEM SOIL. Soil Sci. Soc. Amer. Proc. 22: 1-5, 1958.

A surface sample of Sharpsburg silty clay loam was separated into aggregate fractions of diameters 4760 to 2380μ , 2380 to 1190μ + ... +, 37 to 18.5μ by means of rotary sieves and elutriators. A similar separation was made for primary particles. Each fraction of aggregates was analyzed for chemical and physical properties. The physical properties of aggregates was compared with those of primary particles.

Data on water stability of aggregates show that as the diameter of aggregates decreased the stability increased. Particularly, aggregates of diameter 74 to 37μ and 37 to 18.5μ were different from the other fractions. Some of the differences in properties were: higher degree of aggregation, percentage of primary particles, available phosphorus, and exchangeable Ca^{++} ; lower moisture retention, percentage of organic matter, total nitrogen content, and exchangeable H^+ .

At complete water saturation, aggregates and particles wetted under partial vacuum held greater amounts of water on a volume basis than did aggregates and particles wetted under atmospheric pressure. However, as tension was applied, more water was released from the aggregates and particles wetted under partial vacuum than under atmospheric pressure. At increased tensions, the differences between the two methods of wetting were less marked. At tensions of 0.33 atm. and higher, the moisture contents were nearly identical.

Aggregates treated with VAMA soil additive, under both vacuum-wetting and atmospheric-wetting, released more water at successive tensions than did those without the additive.

Charts and Graphs and 21 references

Nebr. Agr. Expt. Sta., Lincoln, Nebr.

van Bavel, C. H. M. MEASUREMENT OF SOIL MOISTURE CONTENT BY THE NEUTRON METHOD. U. S. Agr. Res. Serv., ARS 41-24. 29 pp. 1958.

The purpose of this report is to acquaint field workers in soil and water conservation research with the neutron method for measuring soil moisture. This is attempted here in simple terms, details of physical or mathematical nature being omitted.

Furthermore, this report gives recommended equipment needs and suggestions for its use. Finally, a discussion of the advantages and limitations of the method is presented as well as pertinent information on precision and calibration.

Although the neutron method for measuring soil moisture content has many advantages in comparison with other existing methods, it is not without problems.

The initial cost of the apparatus ranges from \$1,500 to \$2,000.

A summary of the principal characteristics of the neutron method as described here is as follows:

1. Apparatus consists of a battery operated, portable scaler, a probe, a connecting cable, and a standard.
2. The probe consists of a 2-mc Ra-Be source shielded by 0.8 inch of lead, a boron trifluoride slow neutron counter, and a preamplifier.
3. The probe dimensions are 12×1.875 inches O. D. made to give a close fit in access tubes made of 2-inch irrigation tubing.
4. With 1-minute counting time the moisture content is determined to the nearest 0.5 percent of moisture by volume.
5. The calibration curve is almost linear up to moisture contents of 40 percent. A single curve appears to be valid for many soils, although the possible existence of exceptions to this rule is recognized.
6. The resolution is about 8 inches, but for practical purposes 6 inches can be used.

7. Health hazard due to radiation from the source is very small with simple precautions.
8. Total weight of all equipment is about 30 pounds.

Southwest Water Conserv. Lab., Box 815c, Route 2, Tempe, Ariz.

Burrows, W. C., and Kirkham, Don. MEASUREMENT OF FIELD CAPACITY WITH A NEUTRON METER. Soil Sci. Soc. Amer. Proc. 22: 103-105. 1958.

An experiment to determine the moisture vs time curve, and hence the field capacity, was carried out at 6-inch increments to a depth of 5 feet on 4 soils, (Marshall sil, Ida sil, Thurman sl, and Webster cl). Plots of soil were soaked with water and a soil moisture meter employing neutron scattering used to determine the moisture content of the soil profile at different times following water entry into the soil. The data were plotted as curves of soil moisture content on a volume basis vs time in hours following wetting. The general shape of the curves was about as expected for 2 silt loam soils and 1 sandy loam soil, but certain layers in these 3 soils deviated from the normal pattern. The deviations are explained on the basis of physical conditions of the soil existing some distance from the soil layer in question. A clay loam soil showed extreme variability, with little movement of appreciable quantities of water; a field capacity for it could not be defined. The neutron meter used was found to be an excellent device for this type of study; confounding of soil variation in sampling errors was, through its use, eliminated.

Eastern Soil and Water Mangt. Br., SWC, ARS, USDA, Ames, Iowa.

Lowry, Gerald L. ESTIMATING PERMANENT WILTING POINT IN THE FIELD BY A DIRECT LABORATORY CALIBRATION. Soil Sci. Soc. Amer. Proc. 22: 95-98. 1958.

A method is described whereby soils may be calibrated with fiberglass soil moisture units at 15-atm. tension using the pressure membrane apparatus.

Moisture units to be installed in the field were first calibrated in a shallow pan with a bulk soil sample taken from the site of the proposed field installation. Ten units were selected for further laboratory calibration and the remaining ones installed in the field. Soil samples were spooned into rubber rings, the moisture units imbedded in the soil, and the assemblies soaked overnight in distilled water. The soils and units were subjected to 15-atm. tension for 8 days, after which resistances were determined. Moisture content of the soils was determined in order to validate the run. This procedure was repeated with moisture units rearranged and placed in different soils. Statistical analysis indicate whether or not separate means are required for all soils.

Field moisture curves indicate that under the conditions studied, resistance readings in the surface soil (2-inch depth) may rapidly pass through the wilting range (mean 15-atm., ± 1 standard deviation). Deeper installations in vegetated areas indicate leveling-off in the wilting range.

Oreg. State Col., Corvallis, Oreg.

van Bavel, C. H. M. NEUTRON AND GAMMA RADIATION AS APPLIED TO MEASURING PHYSICAL PROPERTIES OF SOIL IN ITS NATURAL STATE. Extrait des Rapports présentés au Congrès. VI^e Congrès International de la Science du Sol. Paris. 1956.

It is often desirable to measure the physical properties of soil in its natural state and radiation methods are ideally suited for such nondestructive testing. In this paper a discussion is given of the application of radiation methods to the measurement of moisture content and density of soil.

Southwest Water Conserv. Lab., Box 815c, Rt. 2, Tempe, Ariz.

Schnitzer, M., Shearer, D. A., and Wright, J. R. A STUDY IN THE INFRARED OF HIGH-MOLECULAR WEIGHT ORGANIC MATTER EXTRACTED BY VARIOUS REAGENTS FROM A PODZOLIC B HORIZON. *Soil Sci.* 87: 252-257. 1959.

The organic matter of a podzolic B horizon was extracted by a number of reagents varying in pH from 1.4 to 13.1. The infrared spectra of the high molecular weight fractions of these extracts indicated that in spite of the wide variations in pH and chemical composition of the extractants, the material removed was essentially very similar in each case. The ash content of the extracts, after dialysis, varied from 20 to 40 per cent, indicating a possible association of organic matter with clays and metals.

The peripheral groups present were identified as hydroxyls and carboxyls. The infrared spectrum of an ash-free preparation, obtained by electrodialysis, to which iron had been added, indicated that in the extracts, and possible in the soil, the carboxylate groups are associated with metals.

An explanation for the formation of stable zones of accumulation of organic matter, metals, and clays in podzolic B horizons is proposed in the light of the evidence found.

Canada Dept. Agr. Ottawa, Ont., Canada.

Soil Chemistry

Schnitzer, M., Wright, J. R., and Desjardins, J. B. A COMPARISON OF THE EFFECTIVENESS OF VARIOUS EXTRACTANTS FOR ORGANIC MATTER FROM TWO HORIZONS OF A PODZOL PROFILE. *Canada J. Soil Sci.* 38: 49-53. 1958.

A survey was made of the extractive power of 15 reagents for organic matter from the A₀ and B₂₁ horizons of a podzol. All were inorganic except disodium ethylene diamine tetraacetate (EDTA-Na₂) and their solutions ranged in pH from 1.4 to 13.1. The amount of organic matter extracted varied with horizon and with extractant. While only NaOH removed appreciable amounts from the A₀ horizon, Na₄P₂O₇, Na₃PO₄, NaF, Na₂CO₃, NaOH, HF and EDTA-Na₂ extracted > 80 per cent of the organic matter of the B₂₁ horizon. No organic matter from the A₀ horizon extracts passed through a cellulose membrane on dialysis against distilled water whereas the B₂₁ extracts lost from 20 to 70 per cent of their carbon content. The ash content of the non-dialyzable portion of the B₂₁ horizon extracts was high (20-40 per cent), indicating the possible presence of complexes of organic matter with metals such as Fe and Al and with clays. The carbon contents of the same materials ranged between 40 and 50 per cent, suggesting that all extractants removed essentially a similar type of material.

Canada. Dept. Agr., Ottawa, Ont., Canada.

Wright, J. R., Schnitzer, M., and Levick, R. SOME CHARACTERISTICS OF THE ORGANIC MATTER EXTRACTED BY DILUTE INORGANIC ACIDS FROM A PODZOLIC B HORIZON. *Canada J. Soil Sci.* 38: 14-22. 1958.

Organic matter was extracted from the B₂₁ horizon of a podzol soil by both 0.5 per cent HF and 0.5 per cent HCl. Dialysis of the extracts against distilled water reduced the halogen content to less than 0.1 per cent and the iron plus aluminum to between two and three millimoles per gram of organic matter. Further treatment of this water-dialysed material with EDTA and 8-hydroxyquinoline removed almost all of the iron and about two-thirds of the aluminum.

The number average molecular weight of the organic matter, as determined by osmometry, ranged between 47,000 and 53,800. Paper electrophoresis studies showed

that this organic matter consisted chiefly of one component, negatively charged, dark-brown in colour and mobile over the pH range investigated (1.8 - 9.0). Only traces to small amounts of glucose, galactose, arabinose and xylose were detected by paper chromatography in both the HF and HCl extracts even after hydrolysis. In addition traces of rhamnose were found in the hydrolyzed HF extract.

Canada Dept. Agr., Ottawa, Ont., Canada.

Baker, J. H., Peech, Michael, and Musgrave, R. B. DETERMINATION OF APPLICATION LOSSES OF ANHYDROUS AMMONIA. Agron. J. 51: 361-362. 1959.

A qualitative and a quantitative method for measuring directly the application losses of anhydrous ammonia under field conditions are described. In the quantitative method, the ammonia escaping from the soil is caught and absorbed in standardized acid. In the qualitative method, the exposed cross and longitudinal sections of the ammonia band are sprayed with an indicator-gypsum suspension, and the movement of ammonia within the ammonia band and through the crevice left by the applicator blade is clearly shown by the color change of the indicator. The results of these tests would indicate that application losses of anhydrous ammonia from soils at optimum moisture content are negligibly small when ammonia is applied at practical rates even at a depth of only four inches below the surface.

N. Y. State Col. Agr., Cornell U., Ithaca, N. Y.

Sohn, J. B., and Peech, M. RETENTION AND FIXATION OF AMMONIA BY SOILS. Soil Sci. 85: 1-9. 1958.

A study was made of the capacity of several representative New York soils to sorb and fix ammonia into nonexchangeable form. The capacity of the soil to sorb ammonia could be attributed to neutralization of the exchangeable hydronium and aluminum ions as well as to the formation of organic nitrogen compounds upon autoxidation of soil organic matter and simultaneous ammonia fixation.

The destruction of the soil organic matter by oxidation with H_2O_2 markedly decreased the capacity of most soils to fix ammonia into nonexchangeable form. Most of the soils were found to fix more ammonia than K^+ .

From the decrease in the extent of ammonia fixation upon H_2O_2 treatment and the difference between the ammonia- and potassium-fixing capacities of the soils, it may be concluded that at least 50 percent of the amount of ammonia fixed by New York mineral surface soils was due to some reaction of ammonia with the soil organic matter.

N. Y. State Col. Agr., Ithaca, N. Y.

Mitra, S. P., and Singh, Raghbir. LOSS OF NITROGEN FROM ALKALI SOILS. Soil and Plant Food 4: 75-80. 1958.

The authors state that from their experiments: It becomes quite evident that a major portion of the Nitrogen added as artificial fertilizers like urea, ammonium sulphate and sodium nitrate to the alkali soil, is lost without any benefit to it. The loss is maximum in case of urea and minimum in case of sodium nitrate.

Apart from leaching, denitrification and other sources of nitrogen loss which usually occur in soil, formation of ammonium carbonate is an additional source of nitrogen loss in alkali soils. The rate of nitrogen loss is fast in the beginning, which decreases with

time. The percentage of loss is greater at a lower concentration of fertilizer than at a higher concentration. Organic matter and phosphate rocks retard nitrogen loss.

U. Allahabad, Allahabad, India.

Dhariwal, A. P. S., and Stevenson, F. J. DETERMINATION OF FIXED AMMONIUM IN SOILS. *Soil Sci.* 86: 343-349. 1958.

A procedure was developed for the determination of fixed ammonium in soils. Interference resulting from the de-amination of nitrogenous organic compounds was eliminated by extracting the organic matter with hot KOH before removal of fixed ammonium with HF. The method is suitable for the determination of both naturally occurring fixed ammonium and ammonium-fixing capacity. The analysis is rapid and requires only a small quantity of soil.

Elliot sil and C isne sil soils were studied for level of fixed ammonium, carbon and nitrogen relationships and ammonium-fixing capacities. Narrowing of the C/N ratio with depth in the soil profile was found to be due largely to fixed ammonium. The ammonium-fixing capacity of a soil where the predominant clay mineral was montmorillonite was less than that of a soil where the predominant clay mineral was illite.

Ill. Agr. Expt. Sta., Urbana, Ill.

Termer, G. L., Bouldin, D. R., and Lehr, J. R. CALCIUM PHOSPHATE FERTILIZERS: I. AVAILABILITY TO PLANTS AND SOLUBILITY IN SOILS VARYING IN pH. *Soil Sci. Soc. Amer. Proc.* 22: 25-29. 1958.

Availabilities of the phosphorus in six pure crystalline calcium phosphates to rye-grass and Sudangrass were determined in the greenhouse. The crops were grown on three acid soils, Clarksville silt loam, Hartsells fine sandy loam, and Edina silt loam; and on two alkaline soils, Rosebud loam and Webster silty clay loam. Dicalcium phosphate dihydrate was appreciably more available than anhydrous dicalcium phosphate on all soils. Monocalcium phosphate was slightly more available than the dicalcium phosphates on the alkaline soils but was less available on the acid soils. Alpha tricalcium phosphate was nearly as available as anhydrous dicalcium phosphate on the acid soils, but was of very low availability on the alkaline soils. Hydroxyapatite was of very low availability on all soils. Availability of octocalcium phosphates and decreased with increasing liming rates on Hartsells fine sandy loam. A significant correlation was found between the phosphorus extracted by 0.5N NaHCO₃ and the phosphorus uptake by the two crops from the various phosphates. Placing the phosphates in a layer 1-1/2 inches below the surface markedly increased availability to the crops grown in low-phosphorus Clarksville and Hartsells soils, while mixing with the soils was equally effective in the higher-phosphorus Edina, Rosebud, and Webster soils.

Charts and graphs.

Soils and Fert. Res. Br., T. V. A., Wilson Dam, Ala.

Chang, S. C. and Jackson, M. L. FRACTIONATION OF SOIL PHOSPHORUS. *Soil Sci.* 84: 133-144. 1957.

A procedure was developed for fractionation of soil phosphorus into the discrete chemical forms, calcium phosphate, aluminum phosphate, iron phosphate, reductant

soluble (iron oxide coated) iron phosphate, and occluded aluminum-iron phosphate, based on the selective solubility of phosphates in various extractants.

Natl. Taiwan U., Taipei, Taiwan (Formosa).

Matthews, B. C., and Smith, J. A. A PERCOLATION METHOD FOR MEASURING POTASSIUM-SUPPLYING POWER OF SOILS. Canada J. Soil Sci. 37: 21-28. 1957.

An apparatus for continuous circulation of water through a soil sample and a cation exchange resin has been devised by modification of the Lees perfusion apparatus. The amount of exchangeable and non-exchangeable potassium released from the soil and absorbed by the resin was found to correlate highly with the amount of potassium taken up by alfalfa grown continuously in the greenhouse ($r = 0.91$). The rate and amount of release differed for different soils and the rate of release showed little correlation with the original level of exchangeable potassium. It is suggested that the rate of release, i. e., potassium-supplying power, is a soil type characteristic and not a function of management or fertilization. The percolation method proposed will permit ready evaluation of the potassium-supplying power of Ontario soils.

Ont. Agr. Col., Guelph, Ont., Canada.

Scott, A. D., Ahlrichs, J. L., and Stanford, G. ALUMINUM EFFECT OF POTASSIUM FIXATION BY WYOMING BENTONITE. Soil Sci. 84: 377-387. 1957.

Various methods were used to prepare acid Wyoming bentonite suspensions to obtain clay systems that contained much or little exchangeable Al. Using these clays alone or with added $AlCl_3$, the effect of varying pH and added phosphate or fluorides was determined to evaluate the effect of exchangeable and precipitated Al on K fixation.

Two effects of Al on K fixation were observed. In acid bentonite the exchangeable Al ions on the clay enhanced fixation. In neutral systems there was no effect from the Al precipitated with hydroxyl ions alone, but the Al phosphate precipitate decreased fixation. These results indicate that the presence of Al must be considered when K fixation results are interpreted.

The K-saturated $<2-\mu$ Wyoming bentonite used in this investigation fixed about 6 me. K per 100 g. clay when dried at $110^\circ C.$ for 24 hours in the absence of Al. This clay, however, fixed more K when excess K salt was added when the clay was very alkaline, or when the clay was dried at $375^\circ C.$

Iowa Agri. Expt. Sta., Ames, Iowa.

Yoshida, Shoichi., Onishi, Yoshiko., and Kitagishi, Kakuzo. THE CHEMICAL NATURE OF SILICON IN RICE PLANT. Soil and Plant Food 5: 23-27. 1959.

Silicon in the rice leaf blades was characterized by the infrared absorption spectra and dissolution test, and proved to be "Silica gel". It was shown that silica gel and opal are not one, but two different materials. The deposition of silicon in the plant was discussed on the basis of recent advances in silicic acid chemistry. No enzymatic action was assumed for the polymerization reaction of the silicic acid occurring in the plant. A working hypothesis was presented that the polymerized silicic acids fill up apertures of cellulose micelle constituting cell walls and make up a silicacellulose membrane, which is supposed to be mainly responsible for protecting the plant from some diseases and insects.

Natl. Inst. Agr. Sci., Tokyo, Japan.

Goertzen, J. O. and Bower, C. A. CARBON DIOXIDE FROM PLANT ROOTS AS A FACTOR IN THE REPLACEMENT OF ADSORBED SODIUM IN CALCAREOUS SOILS. Soil Sci. Soc. Amer. Proc. 22: 36-37, 1958.

The effects of CO_2 from plant roots in facilitating the dissolution of CaCO_3 and the reclamation of sodic soils was studied by comparing the HCO_3^- concentrations of leachates and the loss of adsorbed Na from pots of cropped and uncropped soils receiving uniform leaching with salt-free water. It was found that the effect of CO_2 on the replacement of adsorbed Na was measureable but small, and of less importance than the effect brought about by the hydrolysis of CaCO_3 upon leaching. Data were obtained which indicate that alfalfa roots release more CO_2 than Rhodesgrass roots, and that more of the CO_2 is retained in the soil at high moisture levels than at low moisture levels.

U.S. Salinity Lab., SWC, ARS, USDA, Riverside, Calif.

Schollenberger, C. J., and Whittaker, C. W. IMPROVED DETERMINATION OF CARBONATES IN SOILS. Soil Sci. 85: 10-13. January 1958.

An apparatus and method for the determination of soil carbonate is described. The principal features are: recirculation within a closed system of the gas in the apparatus to insure complete absorption of carbon dioxide by barium hydroxide; immediate titration of excess barium hydroxide without exposure to the atmosphere; constant shaking of absorption as well as reaction flasks; and the thermostating of the latter to insure constant blanks. When dolomite is present in the sample the reaction flask is thermostated at about 50° C. to provide rapid reaction. The use of long absorption towers and quantitative transfer of solutions from them is eliminated. Bumping troubles experienced in evacuated systems are also avoided. The barium hydroxide offers a delicate qualitative test for carbon dioxide, and the setup is thus adaptable to testing for complete recovery. Accuracy and precision of the method are high.

SWC, ARS, USDA, Beltsville, Md.

Repp, Gertraud I., McAllister, DeVere R., and Wiebe, Herman H. SALT RESISTANCE OF PROTOPLASM AS A TEST FOR THE SALT TOLERANCE OF AGRICULTURAL PLANTS. Agron. J. 51: 311-314. 1959.

Previous experimental and ecological studies of plants native to sea coasts and alkali deserts have demonstrated that salt resistance of protoplasm is the main factor in the salt tolerance of species. Water economy and drouth resistance are also measurably influenced by protoplasmic salt resistance.

The resistance of the protoplasm to various concentrations of sodium chloride was determined in combination with field experiments. The different species of plants had distinct differences in protoplasmic salt resistance and these agreed with field results and practical experience. Protoplasmic salt resistance can, therefore, be used as a test for predicting the salt tolerance of agricultural plants.

Measurements of the increases in leaf succulence on plants grown on salty soil were also in good agreement with the protoplasmic salt resistance and with yield.

Plant Physiol. Inst. U. Vienna, Austria.

As salt accumulation is the prerequisite of the formation of alkali soils, saline soils were produced in the laboratory by adding different amounts of KC₁, NaCl, K₂SO₄, and Na₂SO₄ to the normal soil, having a pH 7.6. It has been found that the pH of the soil extract is less where KC₁ or NaCl were added. Like Na-soils, K-soils are always alkaline and sometimes have higher pH values. Higher pH values can be obtained by treating the normal soil with more concentrated solution of KC₁. The presence of Ca-ions has been found to suppress the hydrolysis of K soils and hence lower pH values are obtained.

U. Allahabad, Allahabad, India.

Winsor, H. W. BORON CONTAMINATION OF SOIL SAMPLES COLLECTED IN PAPER BAGS. *Soil Sci.* 84: 389-394. 1957.

Soil samples are subject to boron contamination if collected in paper bags. Soils of all degrees of wetness, if sampled and dried in aluminum foil, were uncontaminated. With polyethylene plastic bags the boron values were consistently too low.

Fla. Agr. Expt. Sta., Gainesville, Fla.

Bowser, W. E., and Leat, J. N. SEASONAL pH FLUCTUATIONS IN GREY WOODED SOIL. *Canada J. Soil Sci.* 38: 128-133. 1958.

Seasonal fluctuations in pH values were determined on soil samples from a modal Grey Wooded soil (Cooking Lake series). Samples were collected from the A₀, A₂, and B₁ horizons at regular intervals from May to November. During this period the pH of each horizon varied from neutral to strongly acid. These fluctuations appeared to be related to the soil moisture and possibly to the soil temperature regime.

U. Alberta, Edmonton, Alberta, Canada.

Morita, Shuji. NUTRIENT ABSORPTION BY RICE FROM MEDIA CONTAINING DIFFERENT TYPES OF CLAY MINERALS. *Soil Sci.* 86: 336-342. 1958.

Nutrient absorption of rice grown in three kinds of clay minerals, the cation-exchange capacities of which were made equal by mixing with quartz sand, was studied. Equal amounts of nutrient were added to the individual mixtures.

The percentage of all nutrients in the plant, except calcium, decreased and the amount of absorbed nutrients increased with growth. Total absorbed nitrogen was highest in the rice grown in kaolinite and lowest in bentonite. The total uptake of potassium was lower than that in illite except at harvest time. The total quantity of phosphorus was highest in plants grown in kaolinite and lowest in bentonite. The total uptake of potassium was highest by plants from the illite treatment and lowest by plants from the bentonite mixture. The amount of absorbed calcium and magnesium was highest in plants grown in kaolinite, but the accumulation in those grown in bentonite or illite was not appreciably different.

Differences in the lattic structure of the clay minerals account for some of these variances of nutrient uptake; other differences may be due to the physiological nature of the rice plant. Illite and montmorillonite decreased the availability of nitrogen, calcium, magnesium and phosphorus when compared to kaolinite. In illite, some potassium

in the clay crystals seems to become available during growth of rice. Differences in anion-exchange capacity resulted in no variance of phosphorus uptake.

Saikyo U., Kyoto, Japan.

Tejwani, K. G., and Venkatraman, K. V. NUTRITIONAL BALANCE IN FLUE-CURED TOBACCO. *Soil Sci.* 86: 310-312. 1958.

Chemical analysis of the flue-cured tobacco samples under varying soil and climatic conditions indicated that in spite of variations in the chemical composition of the leaves, the cation: anion ratio in all the leaf samples was constant. Any change in the cation sum was accompanied by a corresponding change in the anion sum.

Central Tobacco Res. Inst., Rajahmundry, India.

Nishita, H., Steen, A. J., and Larson, K. H. RELEASE OF Sr90 AND Cs137 FROM VINA LOAM UPON PROLONGED CROPPING. *Soil Sci.* 86: 195-201. 1958.

Experiments were conducted to study the uptake of Sr90, stable Sr, Ca, Cs137, and K by Ladino clover as a function of intensive and prolonged cropping of a contaminated soil using the pot culture method. Uptake by plants was also studied in relation to exchangeable and nonexchangeable forms of these cations in the soil.

The exchangeable Ca, stable Sr, and Sr90 decreased with time of cropping, but the concentrations of these cations per unit weight of dry clover remained, in general, fairly constant among all harvests.

The K uptake by clover decreased as the exchangeable K in the soil decreased. As the K uptake by the plants decreased the uptake of Cs137 increased.

Nonexchangeable K was shown to be available to plants, but the release of nonexchangeable Sr90 and Cs137 to plants could not be assessed by the method used. The fixation of Cs137 in the soil appeared to have increased as nonexchangeable K was decreased by cropping.

The maximum activity of Sr90 and Cs137 removed by a single crop of Ladino clover were 4.42 and 0.13 per cent of dose, respectively. Maximum cumulative total percentages of Sr90 and Cs137 removed by 9 crops obtained over the period of 516 days were 23.69 and 0.72, respectively.

U. California, Los Angeles, Calif.

Atkinson, H. J., and Wright, J. R. CHELATION AND THE VERTICAL MOVEMENT OF SOIL CONSTITUENTS. *Soil Sci.* 84: 1-11. 1957.

The authors summarized information relative to the role of chelation and concluded that it appears probable that complex formation, or chelation, or both play an important role in soil profile development. This paper reports three years' work on the problem and concludes that leaching a calcareous soil material with a chelating agent (EDTA) in a solution of a certain strength can result in the mobilization, transport, and redeposition of iron and aluminum and in the development of a profile with well-defined horizons. It has also been shown that, when the strength of the solution of the same chelating agent is increased sufficiently, serious changes in soil material can result.

Dept. Agr. Ottawa, Ont., Canada.

Hemwall, John B. REACTION OF FERRIC ETHYLEDIAMINE TETRAACETATE WITH SOIL CLAY MINERALS. *Soil Sci.* 86: 126-132. 1958.

Iron chelates, notably ferric ethylenediamine tetraacetate, are recent additions to the constantly growing list of chemicals added to soil. Initial field tests with FeEDTA² proved this material to be a superior agent for relieving iron chlorosis in plants, but more extensive testing revealed instances in which it failed. Failure generally occurred

on soils that were characteristically calcareous or alkaline or both and that contained at least a moderate amount of clay.

An investigation was conducted to elucidate the reaction between ferric ethylene-diamine tetraacetate and clay minerals. It was concluded from this investigation that neither FeEDTA nor EDTA are absorbed by clay minerals, although the clay minerals do cause the loss of Fe from FeEDTA. The loss was the result of the formation of an insoluble precipitate, presumably ferric silicate. Beyond this, no reaction was detectable between clay minerals and FeEDTA.

The Dow Chemical Company, Midland, Mich.

Barrows, Harold L., and Drosdoff, Matthew. A COMPARISON OF METHODS FOR DETERMINING THE BASE-EXCHANGE CAPACITY OF SOME SOILS OF THE LOWER COASTAL PLAIN OF THE SOUTHEASTERN UNITED STATES. *Soil Sci. Soc. Amer. Proc.* 22: 119-122. 1958.

A comparison of 5 methods for the determination of cation-exchange capacity of soils of the Lower Coastal Plain was made on surface and subsoil samples of 4 soil series (Norfolk fsl, Savannah fsl, Lakeland fs, and Red Bay fsl). The methods employed were: (1) direct distillation of NH_4^+ -saturated soils, (2) distillation of ammonia from NaCl extract, (3) barium chloride-triethanolamine, (4) calcium acetate-barium hydroxide, and (5) calcium acetate-flame. On the average, method 3 gave results intermediate between those obtained by methods 1 and 2, method 4 gave low results and method 5 gave high results. The difference in methods varied with the different soils.

CRD, ARS, USDA, Gainesville, Fla.

Brooks, R. H. Goertzen, J. O., and Bower, C. A. PREDICTION OF CHANGES IN THE COMPOSITIONS OF THE DISSOLVED AND EXCHANGEABLE CATIONS IN SOILS UPON IRRIGATION WITH HIGH-SODIUM WATERS. *Soil Sci. Soc. Amer. Proc.* 22: 122-124. 1958.

A theory for describing the process of cation exchange during passage of a salt solution through an exchanger column has been successfully applied to a soil in the field. A fallow plot of soil protected from evaporation was irrigated with water having a sodium percentage of 92 and a total cation concentration of 30 me. per liter. Ceramic cups buried at 15-cm. -depth intervals down to 120 cm. were used periodically to sample the soil solution. Measured values of calcium plus magnesium and sodium in soil solution samples as related to depths of irrigation water applied were in good agreement with values calculated from the theory. The theory holds considerable promise for predicting the effects of irrigation waters upon the dissolved and exchangeable cation status of soils.

U. S. Salinity Lab., SWC, ARS, USDA, Riverside, Calif.

Soil Biology

Stickler, F. C., and Frederick, L. R. RESIDUE PARTICLE SIZE AS A FACTOR IN NITRATE RELEASE FROM LEGUME TOPS AND ROOTS. *Agron. J.* 51: 271-274. 1959.

An experiment was conducted to determine the influence of particle size on nitrate release from tops and roots of four legumes. Immobilization of nitrate nitrogen was generally less intense and release and recovery of leguminous nitrogen were greater with coarsely ground than with finely ground materials. A nitrogen-clay mineral interaction was suggested as a possible explanation of these findings.

Greater nitrate release and greater recovery of added nitrogen were obtained for tops than for roots. Approximately 43, 34, 25, and 19 percent of the added leguminous nitrogen was recovered during 100 days of incubation for tops and roots of alfalfa, sweet-clover, red clover, and Ladino clover, respectively.

Statistical analysis of nitrate release data from different stages of decomposition indicated that important differences among treatments occurred only in the early stages of decomposition.

Kans. State U., Manhattan, Kans.

Nishigaki, Susumu, and Shioiri, Matsusaburo. NITROGEN CYCLES IN THE RICE FIELD SOIL I. THE EFFECT OF THE BLUE GREEN ALGAE OF THE NITROGEN FIXATION OF ATMOSPHERIC NITROGEN IN THE WATER-LOGGED RICE SOILS. Soil and Plant Food 5: 36-39. 1959.

The blue green algae, which exist in the rice soil, was grown on its soil layer without algae inoculation, and the enrichment of total nitrogen was studied, to test the fixation of atmospheric nitrogen by soil blue green algae.

Firstly, this enrichment of nitrogen in soil is not due to the absorption of atmospheric nitrogenous compounds by soil.

Secondly, the enrichment of nitrogen is parallel with the growth of blue green algae on the soil, and the growth of algae is stimulated by treatment with calcium carbonate. Also, this algae growth on the soil layer require irradiation of light, and the increase of nitrogen takes place in the algal layer on the surface of algae layer on the soil and not inside soil layer. In the consequence of these facts under water-logged and irradiated condition the nitrogen fixation in rice soil is due to the blue green algae on the surface of soil and not due to the azoto-bactor inside soil layer.

Thirdly, the balance between the increase of soil nitrogen by fixation and the decrease of soil nitrogen by denitrification was studied using rice soil. The method of comparing the absolute nitrogen fixation of blue green algae between two soils was suggested, by incubating soils in various thickness under waterlogged and irradiated condition, and by extrapolating the increase of nitrogen to zero thickness of soil layer. The fixation of atmospheric nitrogen is more powerful in the rice soil, than that of fresh river bed soil. The nitrogen fixation of the water logged and irradiated rice soil can exceed the denitrification under a favorable condition for the blue green algae.

Finally, it will at least be sure that the fixation of atmospheric nitrogen by blue-green algae is taking part in a decrease of a loss of nitrogen in the Japanese paddy rice fields.

Fac. Agr., U. Tokyo, Japan.

McCalla, T. M., Haskins, F. A., and Frolik, E. F. INFLUENCE OF VARIOUS FACTORS ON AGGREGATION OF PEORIAN LOESS BY MICROORGANISMS. Soil Sci. 84: 155-161. August 1957.

Thirty-three fungi and one actinomycete were isolated from Nebraska soils and tested for their effectiveness in aggregating Peorian loess. In addition, a number of other fungi and actinomycetes were tested for aggregating ability with straw and sucrose as energy sources. Three of the more effective cultures were selected and tested for aggregating ability under various levels of carbon source, moisture, temperature, and time. Large differences in aggregating ability were found among the different cultures.

In general, the aggregation effected with sucrose as a source of energy was considerably higher than that obtained with straw, and only a few cultures were found to promote appreciable aggregation with straw as the carbon source. Under favorable conditions of temperature, moisture, and energy source in the laboratory, the more effective cultures promoted a high degree of aggregation of Peorian loess in a relatively short time (3 to 7 days).

SWC, ARS, USDA, Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Lochhead, A. G. QUALITATIVE STUDIES OF SOIL MICROORGANISMS: XV. CAPABILITY OF THE PREDOMINANT BACTERIAL FLORA FOR SYNTHESIS OF VARIOUS GROWTH FACTORS. *Soil Sci.* 84: 395-403. 1957.

A study was made of the ability of 316 cultures, comprising approximately equal numbers isolated, respectively, from a control field soil and the rhizosphere soils of rye and barley by nonselective procedures, to synthesize in various media five growth factors, namely thiamine, biotin, vitamin B₁₂, riboflavin, and the terregens factor. With all three soils, riboflavin was produced by the highest percentage of isolates under the experimental conditions, followed by thiamine and vitamin B₁₂, somewhat lower proportions being found capable of synthesis of biotin and the terregens factor. In the majority of cases more than one factor was detected when any was produced. One-half the cultures from the control soil formed one or more growth factors and rather higher percentages of the rhizosphere isolates. No rhizosphere effect was noted with either crop in respect to the percentage of isolates producing B₁₂ or TF; with barley, though not with rye, the relative incidence of organisms forming riboflavin, thiamine, and biotin was greater than in the control soil. However, in view of the pronounced increase in total number of bacteria adjacent to the roots, the absolute numbers of organisms capable of producing growth factors were much higher in the rhizospheres. The high incidence which bacteria capable of vitamin synthesis may attain in the rhizosphere suggests that this potentiality may be of significance in the interrelationships between the normal soil microflora, soil-borne plant pathogenic organisms, and the plant, and that the elucidation of mechanisms of infection and control will depend upon adequate consideration of growth-promoting as well as of antagonistic effects.

Canada Dept. Agr., Ottawa, Ont., Canada.

Anderson, G. R. ECOLOGY OF AZOTOBACTER IN SOILS OF THE PALOUSE REGION: II. RESPONSES TO ENVIRONMENTAL CHANGES. *Soil Sci.* 86: 111-116. 1958.

Field plot work revealed that Azotobacter could be established in a population of 10⁶ or more per gram in soils once devoid of the organism. It was necessary only to add an energy source, such as sucrose, and adequate moisture, that is, one-half inch a week. These populations were maintained without further treatment over the winter and survived well into the following summer without any great diminution in number.

Laboratory pot studies correlated well with the field studies. When soil moisture was maintained at 18 to 23 per cent and 1 per cent sucrose added, an artificially induced soil population maintained itself for months at 10⁶ and 10⁷ organisms per gram of Palouse soil.

Palouse soils may be completely lacking in Azotobacter while still being capable of furnishing all the growth necessities except energy and water.

Molds of the *Aspergillus* and the *Penicillium* genera overgrew and limited the growth of Azotobacter colonies. Further, subcultures from such growth to nitrogen-free media usually failed to reveal Azotobacter. With a static Azotobacter population, *Aspergillus* and *Penicillium* may help account for the diminution in numbers.

The factors found to limit Azotobacter growth in the Palouse loess were low moisture and a lack of suitable energy sources.

Idaho Expt. Sta., Moscow, Idaho.

Soil-Plant-Animal Relationships

Dyksterhuis, E. J. RANGE CONSERVATION AS BASED ON SITES AND CONDITION CLASSES. *J. Soil and Water Conserv.* 13: 151-155. 1958.

Range condition classification is a basis for planning ahead several years to economically increase production of native forage on each kind of range land (sites). For the individual operator this entails long-term decisions, such as size of breeding herd.

The amount of the current production that has been grazed is expressed as a degree of use. Proper use from year to year on natural pasture lands permits range improvement

through natural plant succession to the point where a type of vegetation in equilibrium with the soil and climate is reached. Site and range condition class determine what a range can be expected to produce now, and in the future, under various seasons and intensities of grazing.

Today, we can quantitatively determine range condition on many types of sites by relating current species composition to that of the climax. With such knowledge of both current and end product, we can adjust time and intensity of grazing to meet the needs of species higher in secondary succession. Moreover, since change in species composition is the indicator of succession, these changes can actually measure the amount of range improvement that results from different kinds of management.

SCS, USDA, Lincoln, Nebr.

Rhykerd, C. L., Langston, Ruble, and Mott, G. O. INFLUENCE OF LIGHT ON THE FOLIAR GROWTH OF ALFALFA, RED CLOVER, AND BIRDSFOOT TREFOIL. Agron. J. 51: 199-201. 1959.

Alfalfa, red clover, and birdsfoot trefoil seedlings were subjected to various light treatments for 30 and 45 day growth periods in order to evaluate the effect of light intensity and quantity and the length of illumination period on the foliar growth of legume seedlings.

Light intensity and/or quantity had a pronounced effect on the leaf/stem ratio of legume seedlings. The leaf/stem ratios of alfalfa and red clover were high at low light intensities and rather low, less than 1, at high intensities. Birdsfoot trefoil seedlings appeared to respond in just the opposite manner. The leaf/stem ratio of birdsfoot trefoil seedlings was low at low light intensities and became higher with an increase in intensity. However, as the seedlings became older, the leaf/stem ratio decreased at high light intensities. At the end of a 45-day growth period, the leaf/stem ratios of alfalfa, red clover, and birdsfoot trefoil were approximately the same at 3200 f. -c for 12 hours a day.

U. S. Region. Pasture Res. Lab., University Park, Pa.

Perkins, H. F., and Stelly, Matthias. Ca AND Mg CONTENT OF OATS AND CRIMSON CLOVER GROWN ON NORFOLK SANDY LOAM AS AFFECTED BY Na AND K. Soil. Sci. 86: 305-309. 1958.

The effects of Na and K treatments on Ca and Mg content of oats and crimson clover forage and on exchangeable Ca and Mg content of Norfolk sandy loam were investigated during a 2-year period. The Norfolk sandy loam used in this investigation contained a very low exchangeable K and Na supply.

Applications of K or Na or mixtures of K and Na reduced the percentage of Ca and Mg in oats. The same treatments failed to effect changes in the percentage of Ca and Mg in crimson clover with the exception of the percentage Mg which was significantly reduced by K.

Only Na, and 1/3 Na plus 2/3 K, increased total uptake of Ca and Mg by oats, whereas the K and both Na plus K mixture treatments increased the total uptake of Ca and Mg by crimson clover. Both yield and percentage composition influenced these relationships in total uptake by crops.

Under conditions of this experiment treatments failed to produce an effect on exchangeable Ca and Mg and percentage Ca and Mg saturation of the soil.

No correlation was found between Ca and Mg composition of the plant and milliequivalents or percentage saturation of exchangeable Ca and Mg of the soil.

La. State U., Baton Rouge, La.

Fernandex, Ramon G., and Laird, R. J. YIELD AND PROTEIN CONTENT OF WHEAT IN CENTRAL MEXICO AS AFFECTED BY AVAILABLE SOIL MOISTURE AND NITROGEN FERTILIZATION. *Agron. J.* 51: 33-36. 1959.

A field study was made of the influence of soil moisture conditions and nitrogen fertilization on the yield and protein content of wheat produced in a heavy clay soil with a high concentration of soluble salts in the 2 to 4 foot horizon. Wheat was irrigated at the following available moisture percentages: 67, 55, 40, and 1. Nitrogen was applied at the rate of 0, 45, 95, and 135 pounds per acre. The following results were obtained:

Grain yields were increased from 10.2 to 66.5 bushels per acre in the optimum soil moisture treatment and from 9.7 to 35.9 bushels per acre in the driest treatment by the application of 135 pounds of nitrogen per acre.

Straw yields were increased from 0.49 to 4.29 tons per acre in the wettest treatment and from 0.40 to 1.54 tons per acre in the driest treatment by the same application of nitrogen.

Grain yields were increased by 85% and straw yields by 187% owing to soil moisture differences in the wheat fertilized with 135 pounds of nitrogen per acre.

The protein content of the whole grain was decreased by the application of 45 pounds of nitrogen per acre and was increased by large applications of nitrogen.

The protein content of the grain was lowest in the wettest treatment and highest in the driest treatment.

It was concluded that a minimum available moisture percentage of about 30 must be maintained in this soil for the production of maximum grain yields.

Oficina de Estudios Especiales, Ganaderia, Mex.

McDowell, L. L. and Smith, G. E. THE RETENTION AND REACTIONS OF ANHYDROUS AMMONIA ON DIFFERENT SOIL TYPES. *Soil Sci. Soc. Amer. Proc.* 22: 38-42, 1958.

Soil texture had a pronounced effect on ammonia movement and retention. The greatest movement of ammonia occurred in the sand and silt loam soils; and the least movement in the clay. The loss of ammonia from the air-dry, acid sandy soil at a 6-inch depth of application was 44 times the loss from the calcareous clay soil receiving ammonia at comparable moisture and depth. The retentive capacity of a soil for ammonia increased greatly as the texture became heavier. The loss of ammonia from the air-dry, calcareous clay soil was negligible even at the 3-inch depth of application. A considerable portion of the nitrogen applied as anhydrous ammonia was lost to the atmosphere or was fixed in some form making it non-extractable by the chemical analysis used. The amount of ammonia fixed increased with the greater clay content of the soil.

The presence of high concentrations of ammonia in a localized area resulted in the partial breakdown of the soil organic matter. As a result of nitrification and the subsequent increase in hydrogen-ion concentration this condition was no longer observed at the end of 4 weeks of incubation.

Ammonia losses were reduced considerable when the application was changed from 40-inch to 16-inch spacings and the rate applied per acre was maintained a constant.

Charts and Graphs

Agr. Expt. Sta., Columbia, Mo.

Soil Genesis, Morphology, and Classification

Ruhe, R. V., and Daniels, R. B. SOILS, PALEOSOLS, AND SOIL-HORIZON NOMENCLATURE. *Soil Sci.* 22: 66-69. 1958.

Exhumed paleosols commonly occur geographically juxtaposed to modern soils. Use of standard soil-horizon nomenclature, with its inherent genetic bias, may erroneously portray the histories of the juxtaposed pedo-geologic soil landscapes. It is suggested that the nomenclature of exhumed paleosols be differentiated from the nomenclature of

modern soils by insertion of an upper case P preceding the letter designations of the soil horizons of exhumed paleosols. Application of the proposed nomenclature is illustrated.

Lithologic discontinuities of parent materials in which a solum has developed now is designated nomenclature-wise by the use of the subscript u--meaning unconformity. This is a misuse of the term unconformity in the geologic sense. In most cases the superposed parent materials are related conformably rather than unconformably. The vertical sequence of Roman numerals to indicate changes in parent materials, suggested by the Committee on Soil Horizons, adequately handles the problem. Application of the sequence is illustrated.

Soil Survey Investigations, SCS., USDA., Washington, D. C.

Whiteside, E. P. A PROPOSED SYSTEM OF GENETIC SOIL-HORIZON DESIGNATIONS. Soils and Fertilizers 22: 1-8. 1959.

The purpose of this paper is to summarize some recent exploratory considerations in developing a system of genetic soil-horizon designations. The ideas and concepts presented here are reflections of earlier suggestions in the literature, the deliberations of the Soil Horizon Committees of the National Cooperative Soil Survey Work Planning Conferences in the United States, particularly during 1953, 1954 and 1955, and many helpful suggestions received from those who helped to evaluate the 1954 and 1956 mimeographed reports of those committees. In addition the stimulating "Proposal for a Unified Designation of Soil Horizons submitted to the Congress of the Association for Soil Classification and Soil Cartography from Sept. 23-27, 1957, in Bonn, Germany, circulated by E. Muckenhausen" has recently come to the author's attention. Additional help from individuals working with soils throughout the world are needed at this time.

Mich. Agr. Expt. Sta., East Lansing, Mich.

Tamura, Tsuneo., Hanna, R. M., and Shearin, A. E. PROPERTIES OF BROWN PODZOLIC SOILS. Soil Sci. 87: 189-197. April 1959.

Four samples of brown podzolic soils (1 from Massachusetts, 2 from Connecticut, and 1 from New Jersey) were characterized. The mineralogical analysis revealed that a component with a 14 A spacing formerly believed to be vermiculite could be montmorillonite. The true nature of this component was revealed only after the interlayer material was removed before the clays were subjected to the classical tests of expansion and contraction. The interlayer material present in these clays is a form of alumina and not necessarily aluminum ions. Ions may be, however, the initial form of the metal originating from the "hydrogen" saturation of the clays. This is verified by the low base saturation of these soils.

The rapid removal of metals in podzols results in the ready identification of montmorillonite in their A horizon. The slow removal of metals accompanied by probable formation of aluminum hydroxide in the interlayer spaces in brown podzolic soils leads to stabilization of the mineral that exhibits a 14 A spacing. The 14 A spacing could be vermiculite or-as was shown in several brown podzolic soils - montmorillonite; theoretical reasoning does not preclude complete alumination to form chlorite. The rates of clay formation and decomposition will result in an equilibrium clay content of about 10 per cent in brown podzolic soils. These facts all influence plant nutrition and the toxicity of aluminum.

Conn. Agr. Expt. Sta., Storrs, Conn.

Westin, F. C., Puhr, L. F., and Buntley, G. J. SOILS OF SOUTH DAKOTA. Soil Survey Ser. No. 3. March 1959.

This publication describes the characteristics and qualities of the soils recognized to date in South Dakota. Distribution and aerial extent of the soils of the State are shown. The publication is primarily for educational purposes.

S. Dak. State Col., Brookings, S. Dak.

McCaleb, S. B., and Lee, W. D. SOILS OF NORTH CAROLINA: I. FACTORS OF SOIL FORMATION AND DISTRIBUTIONS OF GREAT SOIL GROUPS. *Soil Sci.* 82: 419-431. 1956.

Factors of soil formation in relation to distribution of the Great Soil Groups are discussed for North Carolina. Generalizations are made which show the influence of these factors in the distribution of soils. Red-yellow podzolic soils are the normal soils of this region. Reddish-brown latosolic intergrades are the results of dominance of the basic parent material. The so-called "gray-brown podzolic soils" have developed because of climatic differences, and are to be found only at the higher elevations in the Mountains. It is proposed that these soils be called "acid brown forest soils" because of their acidity, low base saturation, weak profile development, and color.

Poor drainage has caused the formation of the humic and low humic gley soils. These soils have developed some morphological features of the normal soils in the surface horizons.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Storie, R. E., and Harradine, F. SOILS OF CALIFORNIA. *Soil Sci.* 85: 207-227. 1958.

The factors of soil-formation, namely climate, parent material, time, and physiography, and vegetation have a wide range in magnitude and composition and occur in numerous combinations. Thus more than 550 soil series are recognized. These factors and the soils are discussed under 12 soil regions.

U. Calif., Berkeley, Calif.

Fiskell, J. G. A., Gammon, N., Jr., Yuan, T. L., and Zmeskal, O. COLLOIDAL PROPERTIES OF SOME FLORIDA SOILS. *Soil Sci. Soc. Amer. Proc.* 22: 339-343. 1958.

The relationships between the mineralogical nature of the colloid and the moisture equivalent, exchange capacity, and base saturation of several sandy loam and sandy soils are discussed. In profiles of Red Bay, Norfolk, and Tifton fine sandy loams exchange capacity, Ca, Mg, and K decreased with depth but clay content and aluminum saturation of these soils increased. In other Coastal Plain soils, namely Klej, Lakeland, and Bladen profiles, a low major base saturation was found with pH values above 5.0 and a high amount of exchangeable aluminum. Calcareous soils and montmorillonitic soils which also usually overlie calcareous material such as Pompano, Felda, and Sunniland sands contained appreciable aluminum extracted by neutral NH_4OAc . Titration curves were made of clays from several soils which differed in the vermiculite, montmorillonite, kaolinite, quartz, and gibbsite content and considerably different buffering capacities were observed.

X-ray diffraction patterns indicated that the mineralogical nature of the clay fraction is rather similar in all horizons of any particular soil profile with no consistent accumulation of one mineral over another. The significance of the exchange complex of these colloids is discussed in terms of major bases, aluminum, and pH. Examples of the accumulation of phosphate and heavy metals are given.

Fla. Agr. Expt. Sta., Gainesville, Fla.

Prill, R. C., and Riecken, F. F. VARIATIONS IN FOREST-DERIVED SOILS FORMED FROM KANSAS TILL IN SOUTHERN AND SOUTHEASTERN IOWA. *Soil Sci.* 22: 70-75. 1958.

Field and laboratory studies were made of forest-derived Lindley soils formed from Kansan till. Five variants in the present Lindley series were recognized, indicating the wide range in morphological, physical, and chemical characteristics of the series as

presently defined. This range was somewhat comparable to the range in properties observed for Gray-Brown Podzolic soils formed from Wisconsin loess, which range in stage of development from minimal to maximal.

The ratio of exchangeable calcium to magnesium did not show a consistent relationship with content of clay in the B_2 of the Lindley variants. Neither was there a consistent relationship between content of free iron and clay content in the B_2 . As several of the Lindley variants have ferretto zones coinciding with the designated B_2 layer, the lack of precise relationships between exchangeable cations with clay seems to be related to their burial with loess, and resaturation with bases.

There is an apparent relationship of increasing degree of horizon development with decreasing slope for the Lindley variants. However, this is not a simple sequence relationship with topography, as time as well as possibly parent material are also important variables.

Evidently the present Lindley series needs to be subdivided into a number of series.

Charts and graphs.

Iowa Agr. Expt. Sta., Ames, Iowa.

Springer, M. E. DESERT PAVEMENT AND VESICULAR LAYER OF SOME SOILS OF THE DESERT OF THE LAHONTAN BASIN, NEVADA. *Soil Sci.* 22: 63-66. 1958.

Desert pavement and vesicular layer are described as distinct horizons of some Gray Desert soils. Distribution of >2-mm. and <2-mm. particles in the profile along with laboratory tests suggest that accumulation of gravel and stones at the surface to form a desert pavement is not due solely to removal of finer material by wind or water. There has also been some upward movement of coarse fragments from the nearly stone-free layers below.

Some properties of vesicular layers are pointed out by field and laboratory studies. Natural vesicular structure was destroyed by sieving and a new, but similar, structure formed by merely wetting and drying the soil. This led to a hypothesis for origin of the vesicular layer as a pedogenic horizon.

U. Tenn., Knoxville, Tenn.

Soil Mapping and Soil Survey Interpretation

Cooperative Research Under Southern Regional Project S-14. CERTAIN PROPERTIES OF SELECTED SOUTHEASTERN UNITED STATES SOILS AND MINERALOGICAL PROCEDURES FOR THEIR STUDY. *South. Cooperative Series B.* 61. January 1959.

The master project title for S-14 is, "The Influence of Chemical, Physical and Mineralogical Properties of Soils on Their Structure and on Plant Growth." This regional project was developed under the sponsorship of the Southern Regional Soil Research Committee. A technical committee was appointed and the project officially initiated in July, 1950. The project was revised slightly in September, 1950.

Soil series were selected for study on the basis of outstanding importance and extent in several states. An additional consideration of ensuring representation from important Great Soil Groups of the region was a factor. This regional bulletin presents data obtained on chemical, physical and mineralogical properties of this representative group of soil profiles. The ten soil series for which data are included in this bulletin are shown in the following list, together with the Great Soil Groups to which they are assigned. Data on a total of 94 profiles are presented. Each soil series is represented by a minimum of three profiles from at least two states.

<u>Soil</u>	<u>Great Soil Group</u>	<u>Number of Profiles</u>
Appling	Red-Yellow Podzolic	7
Cecil	Red-Yellow Podzolic	8
Davidson	Reddish Brown Lateritic	6
Greenville	Reddish Brown Lateritic	9
Grenada	Red-Yellow Podzolic (Fragipan Planosol intergrade)	7
Houston	Grumusol	5
Lakeland	Regosol (Red-Yellow Podzolic intergrade)	13
Norfolk	Red-Yellow Podzolic	12
Ruston	Red-Yellow Podzolic	16
Sharkey	Grumusol (Alluvial intergrade)	11

Va. Polytech. Inst., Blacksburg, Va.

Dill, Henry W., Jr. USE OF THE COMPARISON METHOD IN AGRICULTURAL AIR-
PHOTO INTERPRETATION. Photogrammetric Engrg. 44-49 pp. 1959.

Obtaining data on changes in the use of agricultural land is an expensive and time-consuming process when field methods are used. The availability of successive airphoto coverage for many agricultural areas, made in the last few years, provides a means of comparing recent conditions with those prevailing before World War II. Two methods developed to provide data by airphoto comparison analysis are described. They overcome the difficulties posed by field survey methods.

The author concludes that: Use of airphoto comparison methodology provides a means of obtaining data on agricultural land uses for economic analysis, with a minimum expenditure of funds, and a small number of professional personnel, in a relatively short time. The two methods allow for a choice of approach, depending on the job requirements. Or, used in combination, they are a good substitute for field mapping, particularly for large areas.

Farm Econ. R. D., ARS, USDA, Washington 25, D. C.

HYDROLOGY

General

Hutchins, W. A., Smrha, R. V., and Smith, R. L. THE KANSAS LAW OF WATER RIGHTS. Div. of Water Resources, Kans. State Bd. Agr., and Kans. State Water Resources Bd., Topeka, Kans. 1957.

This statement of the Kansas law of water rights was prepared as part of the revision of "Selected Problems in the Law of Water Rights in the West," which was issued in 1942 as Miscellaneous Publication 418 of the United States Department of Agriculture. The completed revision will comprise an over-all discussion of water rights law for the seventeen Western States. This overall discussion will be followed by separate statements for each of the States concerned. If practicable, a separate publication for each State is to be issued in advance of publication of the complete revision.

Kans. State Water Resources Bd., Topeka, Kans.

Larson, C. L., and Hermsmeier, L. F. DEVICE FOR MEASURING PIPE EFFLUENT. Agr. Engin. 39: 282-284, 287. 1958.

The principal limitation of the slotted-tube flow meter is that it cannot be used to measure flow which carries debris, such as surface runoff or sewage. However, a moderate amount of sediment does not interfere with its operation.

The merits of the slotted-tube flow meter may be summarized as follows:

It is a relatively simple device. It has no moving parts, which might be subject to binding, sticking, or wear.

It is not sensitive to minor deviations in fabrication and installation, other than the diameter of the test pipe.

It can be used to measure a wide range of discharges, including low flows, with good accuracy.

It has a small head loss.

U. Minn., St. Paul, Minn.

Bouwer, Herman. INTEGRATING RAINFALL-EVAPORATION RECORDER. Agr. Engin. 40: 278-279. 1959.

Use of the balance system to determine when to irrigate involves keeping a daily record of evapotranspiration and rainfall or irrigation, and calculating the moisture balance at the end of each day. This need for daily accounting could be eliminated by a device that would simultaneously measure and "store" evapotranspiration, irrigation, and rainfall, and that would be equipped with an upper "ceiling" representing field capacity and an adjustable lower mark indicating time to irrigate.

The author describes an integrating rainfall evaporation recorder consisting of a lucite cylinder placed in a standard evaporation pan.

His results indicate that accumulated pan-evaporation values can be used for determining the distance AB of the integrating rainfall-evaporation recorder with very little error.

Agr. Expt. Sta. Ala. Polytech. Inst., Auburn, Ala.

Barnes, K. K., and Johnson, H. P. A RUNOFF SAMPLER FOR LARGE WATERSHEDS. Agr. Engin. 37: 813-815, 824. 1956.

Results of laboratory tests of the hydraulic characteristics of a slotted conduit, intersecting the nappe of the flow through a drop-spillway structure, were utilized in the design of a runoff sampler for large watersheds. The equipment for the field installation includes a conduit extending downstream from the notch of a drop-spillway structure, a Pomerene-type sampling wheel which takes 1/100 of the discharge from the conduit, and a 27-cubic foot tank for storage of the sample. The upper edge of the conduit has a sharp-edged slot bounded by surfaces which lie in planes parallel with the axis of the conduit and intersecting at an angle of 60 degrees. This slot is 0.1 inch wide at the crest of the spillway and diverges to 0.8 inch wide at 6 feet downstream from the crest of the spillway. The conduit is depressed 10 degrees from the horizontal.

Iowa Agr. Expt. Sta., Ames, Iowa.

Johnson, H. P., Frevert, R. K. SELECTED INTENSE STORMS IN THE LITTLE SIOUX RIVER WATERSHEDS. Agr. Engin. 26-29. 1959.

Rainfall and runoff records taken during the growing season have been accumulated for a period of eight years on five agricultural watersheds located about 30 miles southeast of Sioux City, Iowa. The watersheds vary in size from 49 to 309 acres. The land slopes are steep, about one-half of the land having slopes greater than 10 percent. Most of the land is under cultivation, about one-third being in row crop, one-third in oats and one-third in hay land or pasture.

Rainfall is measured with recording rain gages. Runoff is continuously recorded at reservoirs or at full-flow spillways.

The first objective of the study, that of securing design information, has been accomplished for the eight-year period. Very high peak rates of runoff from these agricultural watersheds were recorded. For these storms, the rates of runoff varied from 3.5 to 5.6 iph. The peak of over 1600 cfs from the 309-acre watershed is particularly high. The steep slopes, the steep channel grades, the well-defined drainage system and the lack of channel storage result in short times-to-peak on hydrographs. The second

objective, that of determining the effect of structural treatment and land treatment, has been partially accomplished. Evidence of the reduction of flood peaks resulting from reservoir storage was accumulated. However, land conservation practices have not been adopted to a degree necessary to noticeably reduce peak flows or runoff. Plans are being made, pending landowner cooperation, to terrace one watershed in each of the two watershed areas in order that the effects of terracing on runoff may be measured.

Agr. Expt. Sta., Ames, Iowa.

Zingg, A. W., and Hauser, V. L. TERRACE BENCHING TO SAVE POTENTIAL RUN-OFF FOR SEMIARID LAND. Agron. J. 51: 289-292. 1959.

A new concept for the management of runoff water from cultivated lands to control erosion and improve crop yields in semiarid regions is described. A speculative evaluation of the practice known as conservation benching is presented. An experimental field installation of conservation benches is described, and yields and experience for the first crop year are presented. Adequate outlet capacity and provision for drainage are considered to be essential design features. A deviation of ± 0.15 foot from level seems to be permissible for the surface of the bench. Removal of up to 0.9 foot of topsoil from the cut side of the bench appears to lower yields for the first crop produced. However, the relative effect is expected to be less severe after a few years.

Conservation benching appears to be a practice capable of controlling water erosion and adapted to utilizing potential runoff for crop production in semiarid areas.

Watershed Technol. Res. Br., SWC, ARS, USDA, Beltsville, Md.

Hewlett, John D. PINE AND HARDWOOD FOREST WATER YIELD. J. Soil and Water Conserv. 13: 106-109. 1958.

Rainfall over the Appalachian Mountains furnishes some fifty million people with a large proportion of their municipal, industrial, and agricultural water supplies. Future management of such a vast area for both timber and water will raise many questions about the influence of different forest types on water yield. For example, will there be differences in the quantity of water flowing from a hardwood forest when converted to pine? This article tells of one experimental effort to make the conversion and find out.

Coweeta Hydrologic Laboratory, Route 1, Dillard, Ga.

Johnson, J. A. WATER-USE AND WATER-RIGHTS POLICY IS CHANGING. J. Soil and Water Conserv. 14: 3-6, 1959.

Much has been said and written about water resources and the importance of their full development and utilization in the face of expanding human needs. The public is more aware of problems of water use, excess water, damage to water quality, and growing needs for greater quantities of good quality water in an expanding economy. People generally have some understanding of what is being done to solve these problems through conservation and protection programs. State legislatures and water-user organizations are assuming greater responsibilities for education on water facts, but many of us have little opportunity to develop an understanding of what is being accomplished state by state in approaching these problems through water policy legislation.

In some southeastern states, water policies have been formally declared for the first time and water laws and programs have been adjusted in an effort to meet modern needs.

Studies are being continued in most cases. The people and their legislatures recognize that further adjustments will be necessary, if legal institutions and users are to keep abreast of changing conditions.

SCS, Spartanburg, S. C.

Climatology

Hanks, R. J., and Woodruff, N. P. INFLUENCE OF WIND ON WATER VAPOR TRANSFER THROUGH SOIL, GRAVEL, AND STRAW MULCHES. *Soil Sci.* 86: 160-164. 1958.

The influence of wind on evaporation from a wet soil surface has been studied extensively (6), but little information is available on this influence once the soil surface has dried and evaporation becomes limited to water vapor transfer through the dry surface soil.

Data presented indicate that wind has a definite influence on water vapor transfer in soil, gravel, and straw mulches, and that this influence was much greater for gravel and straw mulches than for soil. Evaporation rates were increased 2 to 6 times where soil mulches were used, and 10 to 15 times where gravel or straw was used, when the wind speed was increased from 0 to 25 miles/hour.

Increased depths of mulches, in general, decreased evaporation rates. Most of this reduction was brought about, however, by increasing the depth of mulch from 0 to 0.25 inch.

Soil was a more effective mulch in reducing evaporation than was gravel or straw. Evaporation rates for gravel and straw were 1.3 times greater than for soil at zero wind speed and were 6.3 times greater for 25 miles/hour wind speeds.

The data show that the vapor conductivity of water vapor is increased with increased wind speed, and that diffusive conductivity is increased for a dry soil mulch as the depth to an impermeable layer is increased; the data also suggest, but are not conclusive, that this occurs in gravel and straw.

Kans. Expt. Sta., Manhattan, Kans.

Burnett, E., and Moldenhauer, W. C. USING RAINFALL RECORDS AS GUIDES TO PREDICT YIELDS OF COTTON ON DRYLANDS OF THE HIGH AND ROLLING PLAINS OF TEXAS. Tex. Agr. Expt. Sta. MP-223. August 1957.

This publication presents an analysis of the rainfall characteristics of three locations on the High and Rolling Plains. Probabilities of cotton yields have been designed to aid the farmer in determining cotton yields with various amounts of rainfall.

Tex. Agr. Expt. Sta., College Station, Tex.

van Bavel, C. H. M. ESTIMATING SOIL MOISTURE CONDITIONS AND TIME FOR IRRIGATION WITH THE EVAPOTRANSPIRATION METHOD. U. S. Agr. Res. Serv., ARS 41-11. August 1956.

The evapotranspiration method embodies several laws and experiences from the fields of plant physiology, soil science, and meteorology, but the two most important principles are these.

1. When soil moisture is plentiful, evapotranspiration depends primarily upon weather conditions.
2. The moisture content of the rootzone at a given time equals that at a previous time, plus the difference between income and outgo over the period elapsed (conservation of matter).

It is possible, therefore, by applying these principles to find the moisture content of the rootzone through a measurement or an estimate of gains and losses of water.

In using the evapotranspiration method, the total amount of plant-available water rather than the moisture content of the soil or the tension of the soil water are of direct concern.

Daily measurement of rain at the site of interest is indispensable in the evapotranspiration method.

Inform. Div., ARS, USDA, Washington 25, D. C.

Moldenhauer, W. C., and Keating, F. E. RELATIONSHIPS BETWEEN CLIMATIC FACTORS AND YIELDS OF COTTON, MILO, AND KAFIR ON SANDY SOILS IN THE SOUTHERN HIGH PLAINS. U. S. Dept. Agr. Prod. Res. Rpt. 19, Wash., D. C. April 1958.

Highly significant negative correlation coefficients were obtained between temperatures in June, July, and August and both annual and seasonal precipitation. Highly significant negative coefficients were obtained between temperature and precipitation in each of these months individually. Thus, low rainfall is shown to be associated with high temperature.

Correlations between wind velocity and precipitation were generally very low. There was a highly significant correlation between average maximum wind velocity in March and precipitation in April because of one year in which there was extreme wind velocity in March and eight times average rainfall in April.

For both cotton and milo, the correlation was higher between yield and annual precipitation calculated from September 1 to August 31 than from January 1 to December 31 or from October 1 to September 30. The difference was more pronounced for cotton than for milo.

Precipitation by months was significantly correlated with milo yield in April, June, and August but was significantly correlated with cotton yield only in August.

Average temperatures in June, July, and August were negatively correlated with yields of both cotton and milo. This negative correlation was highest in August for cotton but was very similar in all 3 months for milo. Thus, low temperatures are shown to be associated with high yields.

The coefficient of correlation between available soil moisture for the cotton crop in the 1- to 6-foot soil zone and preseasional precipitation from September 1 to April 30 was 0.825. The coefficient of correlation between available soil moisture in the 6-foot profile and preseasional precipitation from October 1 to May 31 was 0.624.

Office of Inform., USDA, Washington 25, D. C.

Ludwig, J. W. and Harper, J. L. THE INFLUENCE OF THE ENVIRONMENT ON SEED AND SEEDLING MORTALITY. Bibliography on Soil Temperature and Plant Growth, 1951-1958. Commonwealth Bur. of Soils. February 1959.

Small plots of clay soil in the open field were covered with a thin layer of different materials giving colours ranging from white (lime) to black (soot) through various shades of brown and grey (sand and loam). Maximum and minimum soil temperatures at 5 cm (sowing depth) were higher under dark than under light surfaces; diurnal temperature fluctuations, which tend to stimulate germination, were greatest in the dark soil.

Commonwealth Bur. of Soils, Harpenden, Eng.

Aderikhin, P. G. and Tikhova, E. P. CHANGING THE COLOUR OF THE SURFACE OF NORTHERN SOILS. Bibliography on Soil Temperature and Plant Growth, 1951-1958. Commonwealth Bur. of Soils. February 1959.

The time at which the maximum temperature occurs in natural-coloured soil increases from 1 pm at the surface to 10 pm at a depth of 40 cm. Dusting with flour decreases soil temperature at all depths. Dusting with soot or powdered peat increases soil temperature, the increase at the surface occurring in the first half of the day. The changes are greater on sunny than on cloudy days. Dusting with soot or peat increases the contents of NO_3 , NH_4 , available P and available K in the soil. Oats grew better on darkened than on undarkened soil and absorbed greater quantities of nutrients from the darkened soil.

Commonwealth Bur. of Soils, Harpenden, Eng.

This paper presents results of the measurement of natural soil temperatures under a bare ground surface at College Station, Texas, during the years 1951 through 1955, inclusive. Temperature data are given for air and for nine different depths from the ground surface to a maximum depth of 10 feet.

A general equation is developed to describe the annual temperature variation observed at each depth. A discussion of the soil temperature gradients and of the effects of rainfall and resulting soil moisture content changes are included.

Tex. Engin. Expt. Sta., and Tex. A. & M. Col., College Station, Tex.

Korovin, A. I. THE EFFECT OF LOW SOIL TEMPERATURE ON THE EFFECTIVENESS OF VARIOUS FORMS AND RATES OF MINERAL FERTILIZERS. *Bibliography on Soil Temperature and Plant Growth, 1951-1958*. Commonwealth Bur. of Soils. February 1959.

In the Far North $(\text{NH}_4)_2\text{SO}_4$ gave higher grain yields than did $\text{Ca}(\text{NO}_3)_2$ in cold wet summers but in warmer years $\text{Ca}(\text{NO}_3)_2$ was more effective. In pot experiments with soil temperatures of 6-7°C applying half of the N as NH_4 nitrogen before sowing and half as a nitrate topdressing gave higher yields than did application of both forms before sowing. Split application was not more effective with soil temperatures of 15-20°C. At 6-7°C the highest yields were obtained with N + 3P + 1.5 K, the N application being split.

Commonwealth Bur. of Soils, Harpenden, Eng.

Ketcheson, J. W. SOME EFFECTS OF SOIL TEMPERATURE ON PHOSPHORUS REQUIREMENTS OF YOUNG CORN PLANTS IN THE GREENHOUSE. *Canada J. Soil Sci.* 37: 41-47. 1957.

Germinated corn seedlings were planted in Burford loam soil in 1-gal. glazed pots and allowed to grow for 8 weeks in the greenhouse. Two levels of phosphorus, 0 and 20 p. p. m. P_2O_5 , were used, along with a uniform treatment of nitrogen and potassium fertilizer. Carrier-free phosphorus-32 was placed in the bottom of the pot as compared with mixing throughout to indicate regions of root activity. One set of pots, consisting of four replications per treatment, was placed in a water bath averaging approximately 13°C. A corresponding set was placed on the greenhouse bench where temperature averaged approximately 20°C. Air temperature was the same for both sets.

Although the soil used for this study tested high in acid-soluble phosphorus and thereby suggested a low fertilizer phosphorus requirement, the use of phosphorus fertilizer significantly increased both the yield and phosphorus uptake of corn plants. Moreover, the relative increase for fertilizer was much greater under low temperature than under high temperature conditions. This was due to an actual reduction in phosphorus percentage in fertilized plants grown at the higher temperature while the reverse was true at the lower temperature level.

Root activity, particularly in the bottom portion of the pots, was reduced by low temperature, but phosphorus fertilizer partially overcame this effect.

Ont. Agr. Col., Guelph, Ont., Canada.

Garber, R. H. and Halisky, P. M. INFLUENCE OF SOIL TEMPERATURE ON VORTICILLIUM WILT OF COTTON. *Bibliography on Soil Temperature and Plant Growth, 1951-1958*. Commonwealth Bur. of Soils. February 1959.

In cotton inoculated with Vorticillium albo-atrum, average infection percentages were: 50% at 15°C, 75% at 20°, 85% at 25° and 59% at 30°. There was no growth of the fungus at temperatures above 30°C and no wilt symptoms developed at 35°C.

Commonwealth Bur. of Soils, Harpenden, Eng.

Land Use Influences

Gertel, K., Frey, J. C., and Marty, R. J. AN ECONOMIC APPRAISAL OF USE OF IDLE LAND IN POTTER COUNTY, PENNSYLVANIA FOR CROPS, PASTURE AND FOREST. Pa. Agr. Expt. Sta. B. 642, 46 pp., illus. February 1959.

Potter County has 40,000 acres of idle land scattered among farm and nonfarm properties. Use of some of this land for cropland or pasture is promising for farm enlargement or replacement of poorer land, but not for development of new farms. Forest management is promising for owners with considerable time and capital.

Cropping is the most restricted potential use. About 21,000 acres could be cropped with good to fair prospects of returns ranging from \$6 to \$27 per acre, excluding interest on clearing and acquisition costs. Prospects of profitable pasture production are good for most of the idle land. Returns per acre, exclusive of interest on clearing costs, are estimated at \$24 to \$40 per acre for small additions of seeded pasture to existing farms. Three-fourths of the idle land offers good possibilities for profitable investment in forest uses. Cost of planting, exclusive of land clearing, varies from \$12 to \$157 per acre. On appropriate soils, average annual rates of return are estimated to range from 5.6 to 14.2 percent without costs of clearing and land acquisition, and from 4.0 to 11.6 percent with maximum costs of clearing and acquisition.

Pa. Agr. Expt. Sta., University Park, Pa.

Gertel, Karl. PROFITABLE ORGANIZATIONS FOR COMMERCIAL FARMS OF POTTER COUNTY, PENNSYLVANIA. Pa. Agr. Expt. Sta. B. 644, 37 pp. February 1959.

Profitable farm organizations, incomes, and needed additional investments for typical farms are presented. Three different combinations of soil were considered for dairy farms with 50, 100, and 125 acres of cropland. A potato farm with 250 acres of cropland was studied also. The object of the study was to develop goals attainable by Potter County farmers, so input-output relationships for crop and livestock production were generally at the level reported by farmers. Under the suggested organization, "returns" to family would range from about \$5,000 to \$10,000 after allowing for interest on the additional capital for the reorganization. Returns per full-time family worker would average about \$4,000 after allowing for interest on the total farm investment.

Dairy cows were found to be the best choice for the main livestock enterprise, and a few hundred chickens for a secondary enterprise. The poorer croplands would be shifted from crops to grass and legume mixtures, a major change. The excess forage would be harvested as hay or silage. Additional investments needed would range from less than \$1,000 to \$7,700. For farms with 50 acres of cropland, full-time work off the farm combined with part-time farming would be profitable, as would a regular off-farm job for one family member for farm families having two full-time workers. Some custom hiring and some hired labor from May to September would be necessary.

Suggested organizations would not change if prices of eggs and poultry were nearly 10 percent below the projected level. But a 7-percent drop in the price of milk would make a regular off-farm job profitable for all full-time family workers. Woodland operations would probably not be undertaken on the reorganized farms until hourly incomes including stumpage were at least in excess of wage rates, which were estimated at \$1 per hour.

Pa. Agr. Expt. Sta., University Park, Pa.

LeRay, Nelson, Jr., and Crowe, Grady B. LABOR AND TECHNOLOGY ON SELECTED COTTON PLANTATIONS IN THE DELTA AREA OF MISSISSIPPI, 1953-1957. Miss. Agr. Expt. Sta. B. 575, 24 pp., illus. April 1959.

Average acreage of cotton on the 40 plantations studied decreased from 718 in 1953 to 407 in 1957, when only about a third of the cropland was planted to this crop as opposed to three-fifths in the earlier year. The sample was limited to plantations having cotton allotments of 300 acres or more in 1957. Few plantation operators who were faced

with a reduction in acreage of cotton shifted their resources to such intensive enterprises as poultry, dairy, truck crops, and seed production. But the size of livestock enterprises was increased on those plantations already having them. Much of the cotton land was diverted to soybeans, wheat, and corn - the proportion of cropland planted to these crops increased from 29 percent in 1953 to 48 percent in 1957. The importance of the wage cotton crop has continued to increase. Cotton yields were increased through adoption of new practices and greater efficiency of production. The change from hand and mule power to machine power was complicated by the peak demand for hand labor during the chopping and picking seasons and the relatively small demand for unskilled labor during the rest of the year. More cotton was picked by machines - 45 percent in 1956 as against 25 percent in 1953. But in 1957, only 39 percent was machine-picked because of adverse weather. In 1953, only 8 percent and in 1956, 25 percent of the cropper cotton was picked by machine. Yield of lint per acre was highest on the wage cotton acreage.

Labor requirements were lowered roughly 40 percent between 1953 and 1957, mainly because of the shift from intensive to extensive enterprises and the introduction of new techniques. During a normal harvesting season, the bulk of the cotton crop could be picked by machines, but in a year of adverse weather, a shift to hand picking would occur. Large plantation operators have three potential sources of farm labor for seasonal jobs - individuals living on the plantations, day-haul workers, and migratory workers, although few of the latter are employed. The extent to which machines will be substituted for labor in the future will depend largely upon (1) availability and cost of new and improved machines; (2) prices received for cotton and other crops; (3) wage rates for hand chopping and picking; (4) availability of workers skilled in operating and maintaining mechanical equipment; (5) opportunities for nonfarm employment; and (6) government agricultural programs.

Miss. Agr. Expt. Sta., State College, Miss.

Mazurak, Andrew P., and Conrad, Elverne C. RATES OF WATER ENTRY IN THE THREE GREAT SOIL GROUPS AFTER SEVEN YEARS IN GRASSES AND SMALL GRAINS. Agron. J. 51: 264-267. 1959.

Rates of water entry into soils of the 3 great soil groups were measured in the 7th year of cropping to perennial grasses and to annual small grain. On the Brunizem and Chernozem soils, 5 cool-season grasses, 4 warm-season grasses, and small grain rotation were compared. Only cool-season grasses and small grain rotation on the Chestnut soil were compared. Half of each plot was fertilized with ammonium nitrate each spring.

Rates of water entry into soil after two or more hours of irrigation were lower in the grain rotation plots of Chestnut and Chernozem soils than in grass plots. In general, cool-season grasses, as a group, had more favorable effect on soil structure, with respect to water entry into soil during August, than did the group of warm-season grasses. For the same grass, the effect on soil structure was more pronounced in the Chernozem than in the Brunizem soil. The cool-season grasses in the Chernozem soil influenced the soil structure to a greater extent than in either the Chestnut or Brunizem soil. *Agropyron desertorum*, a cool-season grass, maintained a high rate of water entry into soil in all three great soil groups.

Application of ammonium nitrate did not significantly alter the rates of water entry into the soils.

Agr. Expt. Sta., U. Nebr., Lincoln, Nebr.

Sartz, R. S. INFLUENCE OF LAND USE ON TIME OF SOIL FREEZING AND THAWING IN THE NORTHEAST. J. Forestry 55: 716-718. 1957.

Open land soils froze before softwood forest soils, and softwood forest soils froze before hardwood forest soils. Open land soils thawed before softwood forest soils, but after hardwood forest soils.

Northeastern Forest Expt. Sta., Upper Darby, Pa.

Sedimentation

Marston, Richard B. PARRISH CANYON, UTAH: A LESSON IN FLOOD SOURCES. J. Soil and Water Conserv. 13: 165-167. 1958.

For 82 years the abundant clear water supplied by Parrish Creek contributed to the prosperity of Centerville, Utah, a little town 10 miles north of Slat Lake City. But in the summer of 1930 this creek went on a rampage that resulted in a series of four grinding, smashing mudrock floods that deposited 329.9 acre feet of sediment within the town and on surrounding farms. This sediment ranged in size from fine soil particles to huge boulders weighing from 100 to 200 tons.

A commission was set up to study the problem and the following conclusions were made: The Parrish Creek drainage was in stable condition for many years before people settled near it. The normal rate of erosion while it was in this table condition was low. Heavy grazing and burning of the watershed slopes rendered them unstable and increased the sedimentation rate 1,000 times or more. On plots in the head of the canyon, sedimentation rates have been increased from zero to 5.49 acre feet per square mile of watershed during one storm, and decreased from 3.94 acre feet per square mile to zero during a similar storm by manipulation of the vegetal cover.

On steep slopes in this arid region an extremely delicate balance exists between climate, vegetation, and soil. Because the streamflow originating from these slopes is so valuable, any proposed use or harvesting of their vegetation must be so regulated that the hydrologic characteristics will remain normal, thus preventing accelerated soil erosion and destructive flood discharges.

Intermountain Forest and Range Expt. Sta., USDA, Ogden, Utah.

Ground Water

Trimble, George R. Jr., Sartz, Richard S., and Pierce Robert S. HOW TYPE OF SOIL FROST AFFECTS INFILTRATION. J. Soil & Water Conserv. 13: 81-82. 1958.

Hard-frozen ground at times of heavy rain and quick-thawing snow often causes surface runoff with resultant increases in flood hazard and accompanying loss of potential ground water. Thus, in the Northeast or in the other cold regions, ground freezing may have an important effect on streamflow and ground-water storage. Indications are that its single most important effect may be in augmenting flood flows.

Investigators have felt that the inhibiting effect of frozen ground on infiltration depends to a considerable extent on the type of ground freezing. Four terms have been used to describe the structure or type of soil frost: concrete, granular, honeycomb, and stalactite.

In the winter and spring of 1957, approximately 100 ring-infiltrometer tests were made in New Hampshire to study the infiltration characteristics of the frost types commonly found in both open land and forest land. The objectives were to determine if concrete frost as identified in the field was impermeable under both forest and open-land conditions, and to find out to what extent granular frost affected infiltration.

The other two frost types did not appear to warrant investigation.

The author found that concrete frost in the forest and open-land was impermeable, but in the forest it was traversed in places by large open holes that allowed water to enter the soil. Granular frost was more permeable than unfrozen soil.

Northeastern Forest Expt. Sta., USDA, Upper Darby, Pa.

Wilcox, J. C., Holland, W. D., and McDougald, J. M. RELATION OF ELEVATION OF A MOUNTAIN STREAM TO REACTION AND SALT CONTENT OF WATER AND SOIL. Canada J. Soil Sci. 37: 11-20. 1957.

Water samples were obtained from a number of mountain lakes and irrigation reservoirs in the Okanagan Valley, and from streams emptying them. It was found that in any

one drainage basin, the water had a higher pH and salt content at low elevation than at high elevation.

A more detailed investigation was conducted in the Mission Creek watershed. With decreasing elevation the following relationships were found: (a) increasing pH, electrical conductivity, and contents of calcium, potassium and sodium in the stream water; (b) increasing pH and conductivity in seepage water; (c) increasing pH and conductivity in the soil. Relationships between elevation and pH were similar with stream water, seepage water and soil, as also were relationships between elevation and conductivity values.

Expt. Farm, Summerland, British Columbia, Canada.

Townend, C. B. THE ECONOMICS OF THE DISPOSAL OF SEWAGE AND TRADE EFFLUENTS. World Health Organization Bulletin. Palais des Nations. Geneve 20 (4): 535-562. 1959.

In this review of the economics of the disposal of sewage and trade wastes, the author touches on all aspects of the subject, from the annual costs of sewage and sewage-disposal services in England and Wales, and what he terms the "uneconomics" of pollution of natural waters, to the financing of capital expenditure on the construction of new sewage works and equipment and on alterations to existing works. He discusses the purposes and relative costs of the various processes in the treatment of domestic sewage and outlines the special problems involved in the disposal of trade wastes.

Main Drainage Dept., Middlesex County Council, Eng.

Hydraulics - Structures

Silberberger, Leon F. STREAMBANK STABILIZATION. Agr. Engin. 40: 214-217. 1959.

The major streambank control measures that have been used on the Buffalo Creek flood prevention project during the past ten years are discussed in this paper.

The use of rock revetment for bank protection in combination with vegetation as an engineering material is described and illustrated. Precast concrete toe blocks are used where needed.

State Engin., SCS, USDA, Durham, N. H.

Ree, W. O., and Gwinn, W. R. THE VIRGINIA V-NOTCH WEIR. U. S. Agr. Res. Serv., ARS 41-10, 7 pp. 1959.

This is a report of the development and testing of an idea originated in Virginia during a field study relating to the use of highway culverts for runoff measurement. A number of culverts were examined and found to be well suited for the measurement of the higher runoff rates from the watersheds. However, for the lower flow rates, the culvert openings lacked the needed sensitivity. Since a relatively large percentage of the total flow probably occurs at the lower rates, an auxiliary device was needed to measure low flows with the desired degree of accuracy. The Villemonte weir sill used in Oklahoma would not completely satisfy the need because of certain minimum head limitations. Also, the continuous flow would make installation of weir sills within the culvert quite a chore whereas a sill outside the culvert entrance would be easier to construct. These considerations led to the idea of placing a V-notch weir at or near the culvert entrance. For easy reference, the device has been named the "Virginia V-notch."

Tests were made to determine the hydraulic characteristics of V-notch weirs placed on a culvert entrance apron. The V-notch weir and culvert combines made a satisfactory runoff measuring station. The culvert itself is a ready-made measuring device satisfactory for all but the smaller flows. Adding a V-notch weir provides the sensitivity necessary in the low-flow range. Laboratory tests showed the rating to be stable, that is, only one discharge rate occurs for a given head. The presence of the V-notch reduced the

capacity of the culvert, the amount depending upon the height and distance from the entrance. This reduction, for the more practical combinations of height and distance, was 5 percent or less.

SWC, ARS, USDA, Stillwater, Okla.

Keller, J., and Robinson, A. R. LABORATORY RESEARCH ON INTERCEPTOR DRAINS. J. of the Irrig. and Dr. Div. IR 3: 25-40. September 1959.

This paper reports on the results of a large scale model study concerned with the design of interceptor drains. Previously developed analytical relationships for determining the shape of the resultant water table drawdown curve are analyzed. Relationships are developed for estimating the flow from the drains. Examples are given to illustrate the use of the material.

A method has been proposed for determining both the resulting flow and shape of the drawdown curve of an interceptor drain using dimensionless plots. These plots were obtained from experimental data and previously determined theoretical relationships. This method is applicable for cases where a barrier layer is confining the flow through a relatively shallow strata and the source is either known or from engineering judgment an equivalent source is determined.

In many cases where a drain is constructed near the seepage source, such as a canal, the quantity of seepage may be increased to a large extent by the proximity of the drain.

Irrig. Engin., W. R. Ames Co., Denver, Colo.

Remson, Irwin, and Randolph, J. R. ROOT GROWTH NEAR TENSIOMETER CUPS AS A CAUSE OF DIURNAL FLUCTUATIONS OF READINGS. Soil Sci. 85: 167-171. 1958.

Large fluctuations did occur, they resulted from the withdrawal of moisture by vegetation rooted on or near the tensiometer cups. It is possible that this might be a contributing cause to the diurnal fluctuations observed in other installations.

Ground Water Br., Seabrook Farming Corp., Seabrook, N. J.

SOIL AND WATER MANAGEMENT

General

Wickline, E. V. COMMON CHEMICAL HELPS SEAL LEAKY PONDS. J. Soil and Water Conserv. 13: 128-129. 1958.

Twenty-five farm ponds, in the limestone area in Greenbrier County in West Virginia, that were complete failures due to excess seepage, are now holding water satisfactorily as a result of a new chemical treatment of the soil inside the reservoir. Since none of the treated ponds is much more than a year old, it is not known how permanent a seal has been obtained. The results to date appear to justify continued use of the process. The chemical is sodium tripolyphosphate widely used in household detergents. The ponds treated range in size from 1/20 of an acre to 1/4 acre.

Including the cost of machinery, materials, and labor the job can easily be done on the average farm pond for less than 1¢ per square foot.

Sodium tripolyphosphate mixed with moist soil and compacted causes the soil to lose its granular structure and become more dense.

SCS, Lewisburg, W. Va.

Agricultural engineers have a challenging responsibility as leaders in developing methods for increasing production efficiency in American agricultural programs. Full production efficiency, however, can not be achieved if we fail to consider the problems of putting the land itself into shape for maximum efficient and effective operation.

Essentially, this is the process of "land conditioning." It is a multiple approach to many problems. It is "land forming" for improved drainage and irrigation; it is "land smoothing" for high-speed, precision mechanization. It is fitting the field for the application of terraces, diversions, strip cropping, and contour row layouts, and it is a process of eliminating machinery hazards. "Land conditioning" is, then, the application of practices that make good farming, good conservation, and effective and efficient production work together under a modern program of mechanical agriculture.

The "conditioning" of land for more efficient production is also a part of land-use adjustment. By applying land clearing, stone removal, and intensive drainage practices, land having high production capability and lower erosion hazard can be used to replace crop-land unsuited for continued production.

Agr. Engin., SWC, ARS, USDA, Beltsville, Md.

Marschner, F. J. LAND USE AND ITS PATTERNS IN THE UNITED STATES. U. S. Dept. Agr., Agr. Handb. 153, 277 pp., illus. 1959.

This handbook describes some of the more conspicuous landmarks established along the road of progress in land use and productivity, both before World War I and afterward. The first period includes the pre-Columbian era and the time of European settlement, which came to a close at the beginning of the 20th century. In this period, mechanization made a running start. Technological innovations were beginning to be felt. Farm-management studies were undertaken to help farmers organize their operations more efficiently. County agents were appointed for most counties to give farmers advice and counsel when special problems arose.

The new improvements in industrial and agricultural production that occurred after World War I are discussed. It is explained that expansion and contractions in the use of the land for primary production must be expected and accepted as part of the growing pains of the Nation. Problems inherited from the past include damage to land, not all of which has been repaired, and the uncertain boundaries left by the colonies and the States that succeeded them, which are still a source of contention.

In addition to a color map of major land uses in the United States and other maps, 168 aerial photographs are included. The latter are especially useful in showing the different land use patterns, which reflect adjustment of land use to the physical background and the method by which title to the land was acquired.

Inform. Div., ARS, USDA, Washington, D. C.

Fertilizers and Soil Fertility

Mehring, A. L., Adams, J. R., and Jacob, K. D. STATISTICS ON FERTILIZERS AND LIMING MATERIALS IN THE UNITED STATES. U. S. Dept. Agr. Stat. B. No. 191. April. 1957.

In this bulletin an attempt is made to bring together comprehensive statistics of fertilizer production, consumption, foreign trade, and kindred topics, as they relate to the United States. Also included are data on agricultural liming materials, gypsum, and peat. This compilation should serve as an aid in charting the progress in the several phases of the subject; in evaluating national, regional, and State trends in the use of fertilizers and related materials; in studies of the economics of their use in relation to farm income, crop production, and land-management practices; and in guiding their allocation in time of emergency.

Inform. Div., ARS, USDA, Washington 25, D. C.

Duncan, W. G., and Ohlroggee, A. J. PRINCIPLES OF NUTRIENT UPTAKE FROM FERTILIZER BANDS: III. BAND VOLUME, CONCENTRATION, AND NUTRIENT COMPOSITION. Agron. J. 51: 103-106. 1959.

In a greenhouse experiment with corn, fertilizer nitrogen and phosphorus concentrations and the volume of soil fertilized were the controlled variables using phosphatic fertilizer labelled with P^{32} . Phosphorus uptake data during the first three weeks after emergence indicated that uptake of fertilizer phosphorus increases with the area of roots in the fertilized soil and with the amount of phosphorus applied, and tends to decrease with increase of phosphorus in the plant. When the volume of soil fertilized is small in relation to the total soil volume, nitrogen increases the uptake of phosphorus in part by increasing root growth in the fertilized soil.

Purdue U. Expt. Sta., Lafayette, Ind.

Armiger, W. H., Dean, L. A., Mason, D. D., and Koch, E. J. EFFECT OF SIZE AND TYPE OF POT ON RELATIVE PRECISION, YIELDS, AND NUTRIENT UPTAKE IN GREENHOUSE FERTILIZER EXPERIMENTS. Agron. J. 50: 244-247. 1958.

Containers that ranged in capacity from 1 gallon to 3 gallons were as satisfactory as larger containers for greenhouse fertility studies.

SWC, ARS, USDA, Beltsville, Md.

Hendrickson, B. H. A FERTILITY SURVEY OF EXPOSED SUBSOILS FROM HIGHWAY ROAD BANKS IN THE COOSA WATERSHED OF NORTHWEST GEORGIA. J. Soil and Water Conserv. 13: 27-28. 1958.

A greenhouse and laboratory survey was made of the fertility requirements of the B and C horizons of the 7 profiles from the Coosa Watershed of Northwest Georgia. Laboratory analysis showed these soils to be all acid in reaction and to contain only a trace of available phosphorus. The available potash content was variable but generally low.

In greenhouse tests there was an invariable and strong response to nitrogen and phosphorus, indicating that these fertilizer elements must be considered basic to any fertilization program for establishment and maintenance of protective vegetative covers on exposed subsoils of this area.

Soil acidity sharply limited oat forage yields in all but one soil, the Louisburg. Oat forage yield was increased by potash fertilization of some soils but not others depending upon the available K level of the soil.

No very positive response to Esmelin was shown in the greenhouse tests.

Coosa Watershed Res. Proj., Cartersville, Ga.

Eck, H. V., and Stewart, B. A. WHEAT FERTILIZATION STUDIES IN WESTERN OKLAHOMA PROGRESS REPORT, 1954-1955. Mimeo. C. M-281. October 1956.

This publication reports 1954-55 results of wheat fertility experiments conducted since 1951. Results up to date suggest that:

Phosphorus is the first limiting chemical element in wheat growth on many soils in western Oklahoma. Maximum response from nitrogen fertilizer can be expected only after phosphorus needs are fulfilled. Even when it does not affect grain yields, it stimulates early growth and tillering which is important from standpoints of reducing the danger of wind erosion, establishing stands, and providing winter pasture.

Nitrogen fertilizer, when applied on a soil which contains adequate phosphate, will not decrease wheat yields even at high rates and under extreme drought conditions.

It may be advisable to delay nitrogen fertilization of wheat until late winter or early spring. In two of four seasons, there were relatively small yield advantages for spring over fall application of nitrogen. In the other two, there were no differences. By late

winter a farmer is in a better position to know the possibilities of raising a crop and the possibilities of obtaining nitrogen response than he is in the fall.

SWC, ARS, USDA, Agr. Expt. Sta. Okla. A. & M. Col., Stillwater, Okla.

Black, W. N., and Cairns, R. R. THE EFFECT OF VARYING LEVELS OF NITROGEN, PHOSPHORUS, AND POTASSIUM AND MANURE ON THE YIELD AND STARCH CONTENT OF POTATOES. *Canada J. Soil Sci.* 38: 1-7. 1958.

The results of an 8-year fertilizer study on the New London Illustration Station, in Prince Edward Island, are presented. A $3 \times 3 \times 3$ factorial fertilizer study was laid down on potatoes each year in turn in one of four adjoining fields, featuring a 4-year rotation of potatoes, oats, clover and timothy hay. Combinations of N, P_2O_5 and K_2O were applied broadcast as subplots in a split-plot design with two replicates. Manure treatments at 0 and 10 tons per acre were analyzed as main plots. Data were calculated on the yield and starch content of potatoes from two complete rotation cycles.

Manure increased the yield of marketable potatoes by 39.5 and 78.8 bu. per acre, respectively, in the first and second cycle of the rotation. There was no significant interaction of manure by fertilizer treatments. Increased levels of nitrogen and potassium significantly reduced the starch content of tubers but increased yields in proportion to the amounts applied. With phosphorus, no significant yield increases were noted beyond the 120-lb level during the first rotation cycle. In the second cycle, significant increases in yield were obtained, even up to 240 lb. P_2O_5 per acre, with no appreciable effect on potato quality.

Within the scope of this study, fertilizer elements can be applied in quantities to provide economic yield increase without serious reduction of starch content.

Dept. Agr., Charlottetown, Prince Edward Islands, Canada.

Yungen, J. A., Hunter, A. S., and Bond, T. H. THE INFLUENCE OF FERTILIZER TREATMENTS ON THE YIELD, GRADE, AND SPECIFIC GRAVITY OF POTATOES IN EASTERN OREGON. *Amer. Potato J.* 35 (1): 386-395. January 1958.

The effect of fertilizers on the yield, grade, and specific gravity of potatoes were investigated in 16 experiments on irrigated farms in Malheur County, Oregon. In another experiment the effects of variations in nitrogen on changes in specific gravity of potatoes with time were studied. Major emphasis in the experiments was on nitrogen and phosphorus with lesser emphasis on potassium.

Increased rates of nitrogen produced statistically significant decreases in specific gravity of potatoes from 10 of 14 farms on which specific gravity determinations were made. Variations in specific gravity appeared to be related to degree of maturity at harvest. Although statistically significant, differences were of limited practical consequence, nearly all specific gravity values being within the range for good quality.

Phosphorus increased yields on four farms. The soils of these farms were lower in sodium bicarbonate-soluble phosphorus than those of non-responsive farms.

No significant effects of potassium on yields or specific gravity of potatoes were observed.

Idaho Agr. Br. Expt. Sta., Aberdeen, Idaho.

Daines, Robert H., and Bylone, Angelo. TOO MUCH FERTILIZER CAUSES OFF-COLOR IN SWEETPOTATOES. *N. J. Agr.* 41 (3): 10-12. 1959.

In 1957, the harvested Jersey Orange sweetpotato crop showed many white-fleshed roots. This condition, which seriously affected the marketability of the sweets, occurred in a rather large percentage of the plantings. Some fields were observed where as many as 20 percent of the plants produced white-fleshed potatoes.

In an effort to determine the effect of maturity on the keeping qualities of the stored sweetpotatoes an experiment was conducted to study the effects of fertilizer on white fleshed hills and the following results were obtained.

Treatments (amount of 3-9-12 used per acre)	White-fleshed hills, estimated percent		Yields, bu. per acre	
	1957	1958	1957	1958
1. 500 lbs. applied in one side dressing, early.....	Trace	0	259	332
2. 1,000 lbs. applied in one side dressing, early.....	5	0	251	344
3. 2,000 lbs. applied in 3 side dressing, early.....	10	0	228	308
4. 2,000 lbs. applied in 3 side dressings, last application, late.....	20	15	214	272

The author concludes that from the data presented it would appear that the use of excessive amounts of fertilizer, or the use of fertilizer too late in the season, may be undesirable since yields, appearance and flesh color of the Jersey Orange variety may be adversely affected thereby.

Col. Agr., Rutgers U., New Brunswick, N. J.

Juska, Felix V. RESPONSE OF MEYER ZOYSIA TO LIME AND FERTILIZER TREATMENTS. Agron. J. 51: 81-83. 1959.

Field observations have indicated that Meyer zoysia will grow and persist over a wide range of soil types and at very low fertility levels. However, this study shows that Meyer zoysia can be expected to perform more satisfactorily and can be expected to develop a better turf in less time when the soil pH approaches the range between 6 and 7 and adequate amounts of a complete fertilizer are used. Nitrogen is the most important element for rapid top and stolon growth as well as root development. The response to phosphorus was highly significant for top growth and significant for both stolon and root development. In addition, the results indicate that an optimum supply of potassium in conjunction with the other fertilizer elements will hasten stolon growth and spread.

Although Meyer zoysia has been credited by many with the ability to grow and persist at low levels of fertility, it may be concluded that it is not too different in its nutrient requirements from other grasses used for turf purposes.

CRD, ARS, USDA, Beltsville, Md.

Thomas, James R., and Osenbrug, A. EFFECT OF MANURE, NITROGEN, PHOSPHORUS, AND CLIMATIC FACTORS ON THE PRODUCTION AND QUALITY OF BROMEGRASS-CRESTED WHEATGRASS HAY. Agron. J. 51: 63-66. 1959.

The effect of manure, nitrogen, and phosphorus on the yield and protein content of bromegrass-crested wheatgrass hay under semi-arid conditions was evaluated. Ammonium sulfate, treble superphosphate, and horse manure were applied annually in various rates and combinations from 1948 through 1951.

The residual effect of the manure and nitrogen on hay yields was apparent for three cropping seasons.

Nitrogen applications increased crude protein content of the hay and total yield of protein significantly.

Increase in crude protein content from nitrogen application on bromegrass-crested wheatgrass hay was very profitable; however, the hay yield increase was not sufficient to pay for the cost of the nitrogen applied.

High hay yields were associated with grass having a high nitrogen content in those years that manure and nitrogen were applied.

The use of phosphorus produced a significant increase in the total hay yield, but not in protein content.

Low yields were associated with high temperatures. Within the maximum temperature range (60° to 72° F.), yields decreased from 60 to 84 pounds per degree increase in temperature where nitrogen was applied.

The coefficients of determination suggest closer association of the daily temperature range than of seasonal precipitation with yield on the nitrogen treatments. Hay yields were significantly related to the adjusted seasonal precipitation adjusted for effects of the daily range of temperature.

One inch of seasonal rainfall produced 86 pounds of hay per acre on the check treatment compared to 187 pounds of hay per acre per inch of precipitation on the 255-pound nitrogen treatment.

West. Soil and Water Mangt. Res. Br., SWC, ARS, USDA, Newell, S. Dak.

Poysler, E. A., Hedlin, R. A., and Ridley, A. O. THE EFFECT OF FARM AND GREEN MANURES ON THE FERTILITY OF BLACKEARTH-MEADOW CLAY SOILS. Canada J. Soil Sci. 37: 48-56. 1957.

Green manure crops were plowed down in the fallow year of a fallow, wheat, corn, wheat rotation to determine their effect on total organic carbon and nitrogen in the soil and on crop yields.

An average decrease of 27.9 per cent of the organic carbon and 15.9 per cent of the nitrogen in the soil occurred over a 25-year period. Under sweet clover and farm manure the levels of organic carbon and nitrogen were significantly higher than the levels of these constituents under fallow treatment. The levels of organic carbon and nitrogen were not significantly affected by weeds, buckwheat, corn, rye, peas and red clover green crop treatments.

There was little crop yield response to nitrogen-supplying green crops the first year after fallow. However, during recent years there was a gradual increase in yield response to nitrogen-supplying treatments in the second and third crops after fallow. This increased response to nitrogen probably reflected the gradual decline in the ability of the soil to supply nitrogen as total soil organic matter declined.

Expt. Farms Serv., Winnipeg, Man., Canada.

Haas, H. J. EFFECT OF FERTILIZERS, AGE OF STAND, AND DECOMPOSITION ON WEIGHT OF GRASS ROOTS AND OF GRASS AND ALFALFA ON SOIL NITROGEN AND CARBON. Agron. J. 50: 5-9. 1958.

Nitrogen fertilizer increased root weights of three species of grass. Phosphorus increased root weights at the higher rate, while potassium had no effect. Increase in root yield was greatest the first 3 or 4 years after seeding. From 75 to 95% of the roots in the surface 6 inches had decomposed 2-1/2 years after plowing. Changes in soil nitrogen and carbon content during a 5-year period after seeding to grass and alfalfa and after plowing the sod were small.

SWC, ARS, USDA, Beltsville, Md.

Haas, H. J., and Evans, C. E. NITROGEN AND CARBON CHANGES IN GREAT PLAINS SOILS AS INFLUENCED BY CROPPING AND SOIL TREATMENTS. U. S. Dept. Agr. Tech. B. 1164. September 1957.

A study was made of the effect of cropping on the carbon and nitrogen content of the soil at 14 locations in the Great Plains. The period of cropping ranged from 30 to 43 years, and the loss of nitrogen varied from 24 to 60 percent. The average of all locations was 39 percent loss of nitrogen over a 36-year period. Organic carbon losses were similar to nitrogen losses except that they were slightly greater.

Samples were collected periodically at 4 locations. The results at 3 of these locations in Kansas showed a sharp decline in nitrogen the first 10 to 20 years, with a tendency to

level off in the later years. At Sheridan, Wyo., the decline was almost linear, with little leveling off.

An attempt was made to determine whether one type of small grain influenced nitrogen or carbon losses more than another. As nearly as could be determined, there was little difference in their effect on these losses.

Land which had been continuously cropped to small grains, or which had been alternately cropped to small grains and fallow, lost much less nitrogen than that which had been planted to row crops. Alternate small-grain and fallow land lost more nitrogen than that continuously cropped; with row crops, however, the loss was greater under alternate row crop and fallow than under continuous row crop, at only 7 out of 13 locations. The average loss from the surface soil under these cropping treatments at 11 locations was 24 percent for continuous small grains, 29 percent for alternate small grains and fallow, and 43 percent for both continuous row crop and alternate row crop and fallow. Losses from the subsurface soils were considerably less than from surface soils.

Office of Inform., USDA., Washington 25, D. C.

Hunter, A. S., Hall, W. E., and Gerard, C. J. SUBSTANTIAL RESIDUAL EFFECTS OF NITROGEN OBSERVED ON SUMMER FALLOW WHEATLANDS IN OREGON. J. Soil and Water Conserv. 13: 75-76. March 1958.

To make the land as productive as possible is one of the principal objectives of any sound program of soil conservation. Improvement of soil fertility levels is one of the most important means of increasing productivity. It has been demonstrated on many farms in the summer-fallow wheat area of the Columbia Basin counties of Oregon that the yield of wheat may be increased by applications of nitrogen. In recent years the use of nitrogen fertilizer in that area has grown tremendously and is now fairly general.

Pa. State U., University Park, Pa.

Baldwin, C. S., and Ketcheson, J. W. INFLUENCE OF SOIL TEXTURE, REACTION, AND TEMPERATURE ON THE UPTAKE OF NITROGEN FROM THREE NITROGEN FERTILIZERS. Canada J. Soil Sci. 38: 134-142. 1958.

Rye grass was grown on four soils, Schomberg sil (pH 7.8), Bondhead sl (pH 7.2), Oneida cl (pH 6.6) and Fox sl (pH 6.2), in half-gallon glazed pots for a period of 8 months in the greenhouse. A 6-week cool period at 35° F. was employed following the first cutting. Nitrogen was top-dressed at the rate of 80 lb. nitrogen/ac., in the form of either urea, ammonium sulphate or calcium nitrate. These materials were added after germination of the ryegrass in one treatment, and beginning the cool period in a second treatment.

From 50 to 100 per cent of the added nitrogen was recovered in plant material and leachates. Calcium nitrate gave the highest recovery of nitrogen on all soils. No difference was found between ammonium sulphate and urea in the uptake and leaching of nitrogen. Urea was converted to ammonia, at temperatures as low as 35° F. The application of nitrogen before the cooling period extended the period of uptake by the crop.

It was concluded that the behaviour of nitrogen fertilizers in soil is dependent on both the texture and reaction of the soil, that the movement of urea in soil is small, and that the time of application influences the subsequent utilization of these materials by the crop.

Ontario Agr. Col., Guelph, Ont., Canada.

Burleson, C. A., Cowley, W. R., and Otey, G. EFFECT OF NITROGEN FERTILIZATION ON YIELD AND PROTEIN CONTENT OF GRAIN SORGHUM IN THE LOWER RIO GRANDE VALLEY OF TEXAS. Agron. J. 48: 524-525. 1956.

In a field experiment with grain sorghum, applications of 60 and 120 pounds per acre of nitrogen gave significant increases in both content and yield of protein in the grain and forage. Apparent nitrogen recovery was 83.2 and 89.6 percent, respectively, when 60 and 120 pounds of nitrogen per acre were applied.

Lower Rio Grande Val. Expt. Sta., Weslaco, Tex.

Broyles, K. R., and Fribourg, H. A. NITROGEN FERTILIZATION AND CUTTING MANAGEMENT OF SUDANGRASSES AND MILLETS. *Agron. J.* 51: 277-279. 1959.

The combined effects of nitrogen fertilization and cutting intensities on the dry matter yield and nitrogen content of two varieties of sudangrass and two species of millet were studied at Knoxville during the 1957 summer.

The effects of these managements were measured in terms of dry matter yield, percent nitrogen of the harvested forage, and nitrogen yields of the different grasses. Gahi-1 pearl millet produced more total dry matter and nitrogen than did any of the other grasses studied, and was followed by Piper sudangrass, Sweet sudangrass, and German millet, in that order.

As the yields of dry matter of any individual treatment increased, the percent nitrogen of the forage harvested from that treatment decreased. This relationship followed a straight line when the logarithm of both variables was used, and an exponential function when original data were utilized. As cutting intensities decreased and the height of the grasses increased, there was a general decrease in percent nitrogen of the harvested forage. With increases in nitrogen fertilizer applications from zero to 120 pounds of nitrogen per acre, there was a corresponding increase in dry matter yields, nitrogen yields, and nitrogen percentages of the harvested forage.

Ass't. County Agent, Tenn. Agr. Ext. Serv., Knoxville, Tenn.

Hagler, T. B., and Turner, Jack. SOURCES AND RATES OF NITROGEN FOR STRAW-BERRIES. *Ala. Polytech. Inst. L.* 61. 1959.

Foliar sprays of urea increased yield, fruit size, and plant growth of strawberries more than any other source of nitrogen or method of application. A 96-pound rate of N from urea sprays was sufficient for maximum yields.

Soil applications of ammonium nitrate, urea, urea-formaldehyde, and cottonseed meal at each level of N produced higher yields and better plant growth than sodium nitrate.

Organic sources of nitrogen produced greater yields and plant growth than sodium or ammonium nitrates at the highest level of N. Foliar sprays of urea were best at all levels of N.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Grunes, D. L., Viets, F. G. Jr., and Shih, S.H. PROPORTIONATE UPTAKE OF SOIL AND FERTILIZER PHOSPHORUS BY PLANTS AS AFFECTION BY NITROGEN FERTILIZATION: I. GROWTH CHAMBER EXPERIMENT. *Soil Sci. Soc. Amer. Proc.* 22: 43-48, 1958.

An experiment was conducted to determine the effect of source and placement of nitrogen on the relative availability of fertilizer and soil phosphorus to plants. Barley was grown on seven soils in a controlled light-temperature chamber. The addition of nitrogen fertilizer generally increased the percent of the total phosphorus absorbed by plants from bands of concentrated superphosphate. The addition of ammonium sulfate with the phosphorus band was generally more effective in increasing the percent of the total plant phosphorus derived from the fertilizer than was separating the nitrogen and phosphorus bands. Placement of sodium nitrate with, or on the opposite side of the plants from, the phosphorus band were approximately equally effective methods for increasing the percent of the total plant phosphorus absorbed from the fertilizer.

Indications are that the effect of nitrogen, on increasing the relative uptake of banded fertilizer phosphorus, was associated with increased top and root growth, and also with decrease in soil pH.

Detailed studies on one soil indicate that, when the phosphorus fertilizer was thoroughly mixed with the soil, the addition of nitrogen fertilizers did not increase the percent of the total phosphorus absorbed by plants from the fertilizer.

SWC, ARS, USDA, Washington 25, D. C.

Grunes, D. L., Haise, H. R., and Fine, L. O. PROPORTIONATE UPTAKE OF SOIL AND FERTILIZER PHOSPHORUS BY PLANTS AS Affected BY NITROGEN FERTILIZATION: II. FIELD EXPERIMENTS WITH SUGAR BEETS AND POTATOES. *Soil Sci. Soc. Amer. Proc.* 22: 49-52. 1958.

Field experiments were conducted in North and South Dakota, with sugar beets and potatoes grown under irrigation, to determine the effect of nitrogen fertilizer additions on the relative availability of soil and fertilizer phosphorus to plants. The addition of nitrogen fertilizer generally increased the percent of the total phosphorus absorbed by plants from bands of concentrated superphosphate. The percent of the total plant phosphorus derived from the fertilizer tended to decrease later in the season.

Detailed studies with sugar beets at one location indicate that the percent of the total plant P coming from the fertilizer tended to increase with plant growth.

S. Dak. Agr. Expt. Sta., College Station, S. Dak.

Vavra, Joseph P., and Bray, Roger H. YIELD AND COMPOSITION RESPONSE OF WHEAT TO SOLUBLE PHOSPHATE DRILLED IN THE ROW. *Agron. J.* 51: 326-328. 1959.

In soils low in available phosphorus, maximum yields of wheat can be produced by applying soluble phosphate in the row at planting. Evaluation of the efficiency of such applications through the use of the modified Mitscherlich yield equation indicates that it is a much more efficient method than broadcasting soluble phosphate. There was no composition response in the grain for drilled phosphate.

South. Ill. U., Carbondale, Ill.

Weihing, Ralph M., Caldwell, A. G., and Fudge, J. F. PHOSPHATE SOURCES IN PASTURE PRODUCTION ON A BERNARD CLAY LOAM. *Agron. J.* 51: 87-91. 1959.

Rock phosphate, basic slag, and superphosphate, supplying 330, 120, and 120 pounds of P_2O_5 per acre, respectively, were applied to replicated plots on Bernard clay loam in the fall of 1949 to determine their effects upon the production and the chemical composition of mixed grass and clover pasture forage. An additional treatment supplied 180 pounds of P_2O_5 in 6 years from superphosphate applied at 30 pounds each fall (1949-1954, inclusive). Check plots received no phosphorus fertilizers.

Dry forage yields from nonphosphated plots averaged only 1,750 pounds per acre per year for the 6 years, 1950- to 1955. This forage was low in protein and P_2O_5 . Applications of all three sources of phosphorus increased the protein and P_2O_5 content of the forage as well as the yield. Average production of dry forage in pounds per acre per year was 4,900 for the annual application of superphosphate; 4,300 for the single application of rock phosphate; and 3,000 for the single application of basic slag and of superphosphate. Reduction in yield of forage and in its protein and phosphorus contents showed a need for refertilization after 2 years for the single application of basic slag and of superphosphate, and after 4 to 5 years for rock phosphate. The annual application of superphosphate was superior to other treatments in uniform and high production of forage, especially of the clovers, and in the resultant high production of protein from year to year as well as in yielding forage containing a sufficient phosphorus content for beef cattle.

Rice-Pasture Expt. Sta., Beaumont, Tex.

Murdock, John T., and Engelbert, L. E. THE IMPORTANCE OF SUBSOIL PHOSPHORUS TO CORN. *Soil Sci. Soc. Amer. Proc.* 22: 53-57. 1958.

In order to determine the depth to which the corn plant feeds, field studies were conducted to measure the recovery of P^{32} from successive 6-inch soil horizons. The available soil phosphorus in these horizons was determined by the Truog, Olsen, and Bray

No. 2 tests. The accuracy of these tests was checked by correlations with A values and phosphorus uptake data obtained from greenhouse studies.

Corn recovered more fertilizer phosphorus from the 6- to 12-inch horizon of 2 of the 4 soils studied than from the plow layer and in the other soils recovery was almost as great as from the plow layer. Recovery from any layer below the 12-inch depth was considerably less than from the top 2 layers, but the combined recovery from these lower layers was appreciable. This indicates that a large percentage of the phosphorus in the corn plant may come from the subsoil if the subsoil is fairly well supplied with available phosphorus. In most cases, the available phosphorus in the plow layer of the soils studied was greater than that in any of the respective subsoil horizons. However, it was much less than the combined amount found in all of the subsoil penetrated by corn roots.

According to the greenhouse studies the three phosphorus tests used gave an accurate measure of the available phosphorus in the subsoils as well as that in the plow layer.

Charts and Graphs.

U. Wis., Madison, Wis.

Eck, Harold V., and Stewart, Bobby A. RESPONSE OF WINTER WHEAT TO PHOSPHATE AS AFFECTED BY SOIL AND CLIMATIC FACTORS. *Agron. J.* 51: 193-195. 1959.

Data from 53 experiments with winter wheat in western Oklahoma show that soil tests for phosphorus alone, though related to it, are of little value in predicting the yield response to phosphorus under dryland conditions.

Data from 44 of these experiments indicated that consideration of soil moisture at seeding and date of seeding along with soil phosphorus level as determined by NaHCO_3 extraction would not produce a regression equation with which yield response could be predicted with a satisfactory degree of accuracy. Consideration of precipitation, soil moisture at planting, temperature during the ripening period, yield level, and date of seeding along with soil test value improved the estimate of expected response to phosphorus would be quite hazardous.

Simple correlation studies indicated that temperature during the ripening period, yield level, seeding date, soil moisture at planting, and soil phosphorus level as determined by NaHCO_3 extraction were related to yield response to phosphorus of dryland winter wheat.

Standard partial regression coefficients indicated that temperature during the ripening period had the greatest effect on response to phosphorus while soil phosphorus level, precipitation during the growing season, yield level, soil moisture at planting, and seeding date had lesser effects.

Oklahoma Agr. Expt. Sta., Stillwater, Okla.

Smith, F. W., and Grava, J. AVAILABILITY OF PHOSPHORUS CONTAINED IN PHOSPHATIC SHALE COMPARED TO THAT CONTAINED IN MONOCALCIUM PHOSPHATE AND RAW ROCK PHOSPHATE. *Soil Sc.* 86: 313-318. 1958.

It has been suggested that certain phosphate-bearing shales of eastern Kansas might have value as fertilizer materials and for other purposes.

To evaluate more precisely the availability to plants of P contained in these shales, a greenhouse experiment was undertaken January, 1952. It was designed to measure plant growth responses to applications of finely ground shale and to compare such responses with those obtained from applications of other phosphates. These phosphate materials were tested on 10 major soil types.

Upon the basis of these greenhouse and laboratory investigations which were designed to evaluate plant availability of P contained in phosphatic shale, and to compare such availability with that of other phosphatic materials, the following conclusions were made: (a) Availability of P in the shale to wheat plants was so low as to render the material almost completely ineffective as a phosphatic source; (b) P availability in ground Florida phosphate rock, though much below that of $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$, was superior to that in shale; (c) these observations were true for measurements based upon yield data, P percentages

contained in plant material, and data pertaining to actual P uptake by plants; (d) Chemical extraction of available P by a dilute acid-fluoride technique correctly predicted the behavior of both soil P and applied P insofar as availability to plants was concerned.

Kans. State Col., Manhattan, Kans.

Tsubota, Goro. PHOSPHATE REDUCTION IN THE PADDY FIELD. Soil and Plant Food 5: 10-15. 1959.

If the reduction of phosphates takes place in flooded paddy field, this phenomenon might have a great significance from the standpoint of manure utilization in soil. To make clear this problem, the following laboratory experiments were carried out:

- Dephosphorification in a paddy field model,
- Phosphate reduction in liquid medium,
- Isolation of soil bacteria which participate in phosphate reduction.

The results obtained were as follows:

● Using a paddy field model in desiccator, dephosphorification was manifested in the evolved gas by trapping phosphorus compounds in a oxidized form in nitric acid solution.

Among two types of soil investigated, the amount of dephosphorification was large in the soil rich in humus, higher temperature seemed to favour the dephosphorification.

● After one week's incubation of the reductive medium which contained orthophosphate and was inoculated with small amount of soil, considerable amounts of phosphite and hypophosphite could be detected. Accordingly, discussion was made on the possibility that the reduction of phosphate proceeds at least via phosphite and hypophosphite.

● It was demonstrated that among the bacteria which produce the low redoxpotential in their medium, such bacteria as *Clostridium butyricum* and *Escherichia coli* take part in the phosphate reduction.

Tochigi Agr. Expt. Sta., Utsunomiya, Japan.

Hill, W. L. RELATIONSHIPS BETWEEN SURFACE AREA AND FINENESS OF SLIGHTLY SOLUBLE PHOSPHATES. Proc. 4th Tech. Session Bone Char. 1955: 247-266, illus. 1956.

A granule of steamed bone, phosphate rock, or other physically similar material is regarded as an aggregate of non-porous fine grains, the size range of which, though variable, is less than about one micron. An indication of the magnitude of the primitive grain surface is provided by appropriate measurement of the grain size. In the granule the primitive surface is partitioned into outside surface, all accessible to reagents, and inside surface that is usually only partially accessible to reagents used in surface measurement. The greater the penetrability of the reagent, the larger the involved fraction of the inside surface. However, with sufficient reduction in granule size, the surfaces reached by two reagents of the sorption type should become sensibly equal. Accordingly, a plot of the ratios of the two measurements for a wide series of granule sizes would be expected to show a plateau that marks the fineness range in which the ratio is independent of granule size. Measurements on a steamed bone by P^{32} exchange and nitrogen adsorption, when compared in this manner, show a plateau for fineness below about -200 mesh. The value of the plateau ratio, which is also the calibration constant for the exchange, is 62 grams of P per square meter. A similar treatment is applied to the comparison of measured and geometric surfaces of dolomite, calcite and quartz. Phosphate rock apparently lacks the degree of homogeneity requisite for an orderly comparison of surface measurements by different methods.

Bone Char. Res. Proj. Inc., Charleston, 29, Mass.

Phosphorus Work Group of The Western Soils Research Committee. STUDIES WITH
RADIOACTIVE PHOSPHORUS IN SOILS OF THE WESTERN STATES, 1950-53. U. S.
Dept. Agr., Prod. Res. Rpt. No. 12, 32 pp. Wash., D. C. October 1957.

Phosphorus fertilizers are classified into four groups based on water solubility and chemical composition. The first three groups appear to be available to plants in calcareous soils if the surface area exposed to root action is great. These three groups include water-soluble and water-insoluble phosphates. The fourth group, apatite-like minerals, is of very low availability to plants in calcareous soils.

Broadcasting and incorporating P in calcareous soils usually appears to be equal to or better than applying it in bands. However, superiority of a given method of application depends on factors such as type and age of crop, soil fertility, moisture supply and time of application.

By limiting root extension and the solubility of P, low levels of soil moisture may favor a greater P uptake from applied fertilizer than from the indigenous P in the soil. This is especially important when the fertilizer is applied in bands.

Loss of applied P in calcareous soils by reversion to unavailable form is not generally regarded as serious.

Under similar conditions of soil and fertilizer, various crops differ in their ability to obtain P from the soil (both indigenous and applied).

In scientific literature, nitrogen fertilizers have been reported to both increase and decrease applied P uptake by crop plants. Two of the experiments reported herein are inconclusive and two show that N fertilizers favor increased uptake of applied P.

Inform. Div., ARS, USDA, Washington 25, D. C.

Dean, L. A. THE AVAILABILITY OF SOIL AND FERTILIZER PHOSPHORUS TO PLANTS. Commission on Radio Active Isotopes in Agr. U. S. Atomic Energy Commission TID 7512: 53-60, 1956.

This is a discussion that reviews much of the literature pertaining to the application of radioisotopes in the study of the availability of soil and fertilizer phosphorus to plants.
SWC, ARS, USDA, Beltsville, Md.

DeMent, Jack D., and Stanford, George. POTASSIUM AVAILABILITY OF FUSED POTASSIUM PHOSPHATES. Agron. J. 51: 282-285. 1959.

Slowly soluble sources of K under certain conditions may offer advantages over commonly used more soluble forms by reducing leaching losses, luxury consumption by plants, fixation, and salt injury.

Availability of K in a series of fused potassium phosphates (consisting principally of KPO_3 or $K_2CaP_2O_7$) and in comparison with KCl and K_2SO_4 was measured in conventional greenhouse pot tests with corn and in short-term uptake tests with oats on Ruston fine sandy loam. Availability to corn of K in smaller than 35-mesh K phosphates ranging in water solubility. The phosphates supplied as much K to corn during 3 successive cropping periods of 7, 6, and 7 weeks as did KCl and K_2SO_4 .

Short-term uptake of K by millet during a 1-week period following application indicated that all of the minus 35-mesh K phosphates dissolved rapidly in the soil and were equal in availability to KCl . K phosphates of low water solubility (7 to 31%) applied as - 6 + 9 mesh particles, however, were much lower in availability during this period. This particle size effect was still evident to a lesser extent after the phosphates had reacted with the soil for two weeks prior to measurement of K uptake.

TVA - Wilson Dam, Ala.

Doll, E. C., Hatfield, A. L., and Todd, R. EFFECT OF RATE AND FREQUENCY OF POTASH ADDITIONS ON PASTURE YIELD AND POTASSIUM UPTAKE. Agron. J. 51: 27-29. 1959.

Heavy initial applications of potassium were compared with annual applications on a grass-legume pasture during 1954-57 inclusive on Manitou sil, very low in available phosphorus and potassium. The results and conclusions may be summarized as follows:

When totals of 200 and 400 pounds of K₂O were applied as either one initial or four equal annual applications, respectively, no differences in total yield for the 4 years were obtained. However, in 1957 a higher yield was obtained for the 100-pound annual treatment than for the 400-pound initial treatment.

Potassium analyses of the herbage indicated that much of the potassium applied by topdressing is removed the first year.

Soil tests showed a slight increase in exchangeable potassium when 200 pounds of potassium were applied annually, but no increases were noted from any of the other treatments.

The effectiveness of the initial as compared with the annual applications is thought to be associated with fixation of potassium applied initially with subsequent release over a longer period.

The capacity of this soil to fix and/or release potassium at the proper rate to maintain optimum yields of grass-legume pasture is limited to a period of about three years when the potassium is applied at time of seeding.

U. Kentucky, Lexington, Ky.

Smith, J. A., and Matthews, B. C. RELEASE OF POTASSIUM BY 18 ONTARIO SOILS DURING CONTINUOUS CROPPING IN THE GREENHOUSE. Canada J. Soil Sci. 37: 1-10. 1957.

Eighteen Ontario soils were ranked according to their capacity to supply potassium from non-exchangeable forms to eight successive crops of alfalfa. This capacity was found to be closely related to the percentage of clay in the soils. Potassium content of the alfalfa and total uptake of potassium were highly correlated with both exchangeable soil potassium and release of potassium from non-exchangeable forms. Exchangeable potassium levels below 100 lb. per acre gave low yields and potassium content of the crop. Excessively high exchangeable potassium levels resulted in luxury consumption of potassium by the crop or in fixation by the soil. In soils at or near their equilibrium exchangeable potassium levels, i. e., not heavily fertilized, there was a close relationship between potassium-supplying power and the exchangeable potassium content measured either before cropping commenced or at the end of the cropping period.

Ontario Agr. Col., Guelph, Ont., Canada.

Barber, Stanley A. RELATION OF FERTILIZER PLACEMENT TO NUTRIENT UPTAKE AND CROP YIELD: II. EFFECTS OF ROW POTASSIUM, POTASSIUM SOIL-LEVEL, AND PRECIPITATION. Agron. J. 51: 97-99. 1959.

Both soil-level and row applications of potassium were effective in significantly increasing the potassium content and the yield of corn, and the potassium content of the wheat plant. The residuum of these two types of placement significantly increased the yields and the potassium contents of soybeans and hay. In a supplemental experiment row or broadcast applications were equally effective for corn. When compared with broadcast applications of the respective nutrient and where 50 pounds per acre per year or more were used, row applications of potassium were relatively more effective than row applications of phosphorus. Apparently potassium in the row either moves into a greater volume of soil than does phosphorus or the corn roots are able to absorb potassium more effectively from a small volume of soil.

A significant correlation between the relative response to potassium and precipitation during the growing season was obtained with both corn and soybeans.

Purdue U. Expt. Sta., Lafayette, Ind.

Olsen, R. A. ABSORPTION OF SULFUR DIOXIDE FROM THE ATMOSPHERE BY COTTON PLANTS. *Soil Sci.* 84: 107-111. 1957.

Cotton plants were grown in nutrient solutions containing 0.1, 2, 5, 10, and 50 p.p.m. sulfate. Atmospheric sulfur dioxide was excluded from the roots and the sulfate in the nutrient solution was labeled with S35 to permit determination of the amount of sulfur which was absorbed by the plants directly from the atmosphere.

Growth and sulfur content of the plants were sensitive functions of the concentration of sulfate in the nutrient solutions.

The data indicate that sulfur dioxide was absorbed by the growing plants directly from the atmosphere. The amount absorbed was roughly proportional to the size of the plant and was presumed to be a function of the effective leaf surface. According to the data, healthy cotton plants obtained about 30 percent of their sulfur from the atmosphere. Over 50 percent of the sulfur in sulfur-deficient plants was apparently absorbed directly from the atmosphere.

For satisfactory growth of the cotton plants, the sulfur dioxide of the atmosphere was inadequate as the sole source of sulfur. Nevertheless, atmospheric sulfur dioxide contributed a large percentage of the sulfur taken in by the plants, and it is concluded that absorption of sulfur dioxide provided an important supplementary source of sulfur to the growing plants.

SWC, ARS, USDA, Beltsville, Md.

Foy, C. D., and Barber S. A. MAGNESIUM ABSORPTION AND UTILIZATION BY TWO INBRED LINES OF CORN. *Soil Sci. Soc. Amer. Proc.* 22: 57-62. 1958.

Certain corn inbred lines are known to differ widely in the magnesium accumulating abilities of their leaves. The purpose of this investigation was to test the hypothesis that such differences in "magnesium feeding power" can be explained by differences in root properties. Corn inbred lines Indiana WF9 (high leaf magnesium) and Ohio 40B (low leaf magnesium) were selected for comparison.

Results indicate that low levels of magnesium in Ohio 40B leaves were not due to any lack of magnesium adsorbing or absorbing ability on the part of roots of this plant. Roots of Ohio 40B had a higher total cation-exchange capacity and adsorbed magnesium more rapidly from solution than did those of Indiana WF9.

Ohio 40B leaves were always lower in magnesium content than those of Indiana WF9 whether plants were grown in sand culture or soil. Stems of Ohio 40B plants contained a higher percentage of magnesium than did those of Indiana WF9, and this magnesium was more difficult to the extract with 1N ammonium acetate.

It is concluded that the low concentration of magnesium in Ohio 40B leaves is due, primarily, to an immobilization of magnesium in the stems of this plant.

Agr. Expt. Sta., Purdue U., Lafayette, Ind.

Nielsen, K. F. RATE OF CHANGE OF pH IN SOME ACID SOILS DUE TO LIMING. *Canada J. Soil Sci.* 38: 114-119. 1958.

Lime at the rate of 0, 3,000, 6,000, 12,000 and 24,000 pp2m was applied to four acid soils and allowed to incubate for a period of 140 days. The rate and extent of change in pH was followed.

In all four soils the rate of reaction was very rapid and most of the increase in pH was obtained within 3 days after application. At all rates of liming in the four soils there was a general decrease in pH following the peak obtained within the first 30 days.

It was also found that the rate of change in pH of a soil that had been limed was greatly influenced by the moisture content. The change in pH was much more rapid and extensive at 25 per cent moisture than at 10 per cent.

Central Expt. Farm, Ottawa, Ont., Canada.

Whittaker, Colin W., Erickson, C. J., Love, Katharine S., and Carroll, Dorothy M.
LIMING QUALITIES OF THREE CEMENT KILN FLUE DUSTS AND A LIMESTONE IN
A GREENHOUSE COMPARISON. *Agron. J.* 51: 280-282. 1959.

Cement kiln flue dust is a waste product that is sometimes sold to farmers for its potash content. Many such dusts, however, are too low in potash to enter such a market. The composition of these dusts suggests that they may be effective liming materials and at least one producer has sold such dust as a "potash-liming material." The use of the dusts solely for soil liming, however, has received but little attention.

This paper describes a greenhouse experiment in which 3 representatives cement kiln flue dusts are compared with agricultural limestone as liming materials at 6 liming rates for the growing of alfalfa on 2 soils. Conditions chosen that the effect of varying potash content of the dusts and of possible varying minor element content of the liming materials should have had no effect on yield.

Yields from the dust-limed cultures were generally slightly higher than from limestone treated cultures. Apparent over-liming effects, evidenced by yield reduction at higher liming rates, were about the same with the dusts as with limestone.

Calcium content of the dried plant material tended to increase and the potassium content to decrease as the liming rate increased. Similarly in successive cuttings calcium tended to increase and the potassium content to decrease. These two effects were about the same with limestone as with the dusts.

Soil pH was affected by all liming materials in a very similar manner both as regards effect of liming rate and maintenance of pH under stress of cropping.

In ability to increase alfalfa yields cement kiln dusts tended to be superior to agricultural limestone in this experiment. In effects on soil pH, overliming, and on calcium and potassium content of the crop they were very similar to limestone.

SWC, ARS, USDA, Beltsville, Md.

Tensho, Kiyoshi, Yeh, Ko-ling, and Mitsui, Shingo. THE UPTAKE OF STRONTIUM-90 AND CALCIUM BY LOWLAND AND UPLAND RICE FROM SOIL, AND THEIR DISTRIBUTION IN THE PLANTS. *Soil and Plant Food* 5: 1-9. 1959.

The pot experiments, using strontium 90 and Tanashi volcanic ash soil, of lowland and upland rice were conducted by three different ways of applying Sr-90; basic mixed application with the upper two-thirds of the soil, basic surface application and top dressing at the young panicle formation stage (for lowland rice only). In these experiments the absorption of strontium 90 and calcium through the roots and their movement and distribution in the plants was studied, with major emphasis on comparison between these two elements.

(1) The content of Ca and Sr-90 based on air dry basis is high in the stems and leaves, and extremely low in heads, particularly those of hulled rice. Both elements show uniform distribution in all parts of plants. That is to say, generally, the content of these two elements is highest in lower leaf-blades, followed by upper leaf-blades, stem and sheath, husk, rachis, hulled rice, and polished rice in the order mentioned.

(2) The ratio of Sr-90 to Ca, however, is not uniform in all parts of a plant. It was shown that this ratio is lower in the seed part, that is, husk and hulled rice, than in any other parts, irrespective of the kind of plants and the method of Sr-90 application. No distinct difference was noticed in this ratio among bran, hulled rice and polished rice. Considering that this ratio is unusually low in the lower leaves of lowland rice in the top dressing pot, we made it clear that redistribution of Sr in plants is difficult.

(3) The ratio of Sr-90 to Ca is slightly higher in plants for mixed application than in the exchangeable part of the upper two-thirds part of soil after harvesting, but the ratio is lower in plants than in the hot-HCl extractable part of the soil.

(4) The amount of Sr-90 absorbed into plants differs depending upon the method of applying Sr-90. In the case of lowland rice, this amount is largest in top dressing followed by surface and then mixed application. In the case of upland rice, on the other hand, Sr-90 absorption is remarkably low in the surface application. Sr-90 absorption rate was 0.82-1.66% for lowland rice and 0.19-0.53% for upland rice.

(5) The ratio of Sr-90 to Ca, depending upon the method of applying Sr-90, also showed a trend similar to the aforesaid trend in Sr-90 absorption. In the mixed application, however, no striking difference was noticed between lowland and upland rice.

(6) These results have indirectly verified that the unusually high S. U. value of contamination of the grains of rice and wheat, which was shown in the survey of Sr-90 contamination of crops, is not mainly through the roots, but is attributable to direct contamination caused by radioactive fallout. Moreover, it is suggestive that the superficial development of active root system of lowland rice may contribute to the higher contamination of Sr-90 via roots as compared with upland crops.

Fac. Agr., U., Tokyo, Japan.

Wahhab, A., and Bhatti, H. M. TRACE ELEMENT STATUS OF SOME WEST PAKISTAN SOILS. Soil Sci. 86: 319-323. 1958.

The study of the trace element status of soils gained great importance because of the conspicuous roles of these elements in plant and animal nutrition. Practically no information is available in West Pakistan, however, on the quantities of the various elements present in the soils of this country. Moreover, certain serious plant diseases here, such as premature opening of cotton bolls and mango malformation, may be the manifestation of physiological disorders caused by an improper supply of trace elements. It is the purpose of this study to acquire information regarding the trace element status of West Pakistan soils.

Soils from various localities of West Pakistan were analyzed for total Cu, Zn, Mn, and Co, and the average quantities found were 45, 51, 547, and 12 ppm., respectively. Zn and Co showed a good positive relationship with soil texture; Cu shows little change at texture of sandy loam and heavier whereas Mn shows comparatively little increase with soil heaviness.

Agr. Col., Lyallpur, Pakistan.

Termer, G. L., and Brown, B. A. CROP RESPONSE TO BORONATED FUSED TRICALCIUM PHOSPHATES. Sci. 86: 47-53. 1958.

Borax ($Na_2B_4O_7 \cdot 10 H_2O$) is commonly supplied to correct boron deficiencies in some soils. Although this highly water-soluble material is satisfactory under many conditions, it has the disadvantage of being extremely toxic to plants in oversupply and also of being easily leached from some soils. A source of B which is slowly soluble yet furnishes sufficient B for plant growth would have many advantages.

Results of the greenhouse experiments in which the various phosphate materials were applied at a uniform rate of P_2O_5 indicated that fusing borax with rock phosphate in the preparation of fused tricalcium phosphate decreased the availability of the P to the plants. Solubility of the P in citric acid was also decreased.

Results of the experiment in which boronated FTP fertilizers were used primarily as a source of B indicate that these materials did not supply sufficient B to plants grown in greenhouse experiments at the rates of application used. These results are not surprising in view of the very low water-soluble B content of the fertilizers. The ratio of B to P in the test materials is so wide that it would be necessary to apply an excess of P to provide adequate B.

More suitable fertilizers may be produced by fusing B in other preparations of fused tricalcium phosphates, fused potassium phosphates, calcium metaphosphate, or other fertilizer materials. Experimental calcium metaphosphates and fused potassium phosphates containing as much as 5 per cent B have recently been prepared by TVA but agronomic tests have not been made. Fertilizers supplying P, K, and B to plants would have obvious advantages over a material supplying only B.

Tenn. Val. Authority, Knoxville, Tenn.

Holden, E. R., and Engel, A. J. BOROSILICATE GLASS AS A CONTINUING SOURCE OF BORON FOR ALFALFA. *Agr. and Food Chem.* 6: 303. 1958.

Crop response to residual borosilicate glass and uniformity of boron release from such a glass were evaluated in a greenhouse experiment by growth of alfalfa on Evesboro soil cultures during a second year after treatment. Boron content of the crop was sustained in substantially the same range as that obtained with the newly placed glass in the first year.

SWC, ARS, USDA, Beltsville, Md.

Bishop, R. F., and Cook, R. L. LABORATORY AND GREENHOUSE STUDIES ON EFFECT OF LIME AND OTHER AMENDMENTS ON WATER-SOLUBLE BORON IN SOIL. *Canada J. Soil Sci.* 38: 27-35. 1958.

Greenhouse and laboratory experiments were used to study the effect of various soil amendments on the water-soluble boron content of a strongly acid soil.

In the greenhouse, using ladino clover as the test crop, liming reduced boron availability as measured by soil and plant analysis. Calcium-boron ratios in the clover ranged from approximately 550.1 to 2000.1 and there was a significant correlation between the water-soluble boron in the soil and the boron content of the clover.

In the laboratory studies calcium and magnesium carbonates were equally effective in decreasing water-soluble boron in soil. Gypsum was ineffective. Manure or alfalfa hay increased the water-soluble boron of soil in proportion to the amounts applied. Applications of sodium hydroxide, resulting in a range of soil pH values from 4.82 to 9.72, were accompanied by decreases in water-soluble boron until a pH of approximately 8.0 was reached. Above this point water-soluble boron increased. At comparable pH values of approximately 7.0 or less, sodium hydroxide caused a smaller reduction in water-soluble boron than did either calcium or magnesium carbonate.

Sci. Serv. Lab., Kentville, Nova Scotia, Canada.

Ouellette, G. J. PERSISTENCE OF BORAX IN SANDY SOILS. *Canada J. Soil Sci.* 38: 77-84. 1958.

A field experiment was conducted on St. Pacome sandy loam to study the movement and accumulation of applied boron within the soil profile, and consequently determine the optimum rate and frequency of borax application to the sandy soils of Eastern Quebec for the production of alfalfa hay and seed. From 65 to 75 per cent of the borax applied, depending upon the rate used, had moved below the 36-inch depth 30 months after application. The remaining portion was found, mostly in water-soluble form, below the 16-inch depth in the case of plots which had received borax at the 10- and 15-lb. rates, and in the entire profile, but with greater concentration in lower depths, in the case of plots which had received 25 and 40 lb. per acre. Very little fixation of the boron applied occurred between the surface and the 36-inch depth. The biennial application of 15 to 20 lb. of borax for alfalfa hay and 25 to 30 lb. for seed appeared satisfactory on that soil.

Canada Dept. Agr., Ste. Anne de la Pocatiere, Quebec, Canada.

Baker, A. S., and Cook, R. L. GREENHOUSE STUDIES ON ALFALFA WITH SOIL TYPE, SOIL REACTION AND BORAX FERTILIZATION AS VARIABLES. *Agron. J.* 51: 1-4. 1959.

Alfalfa was grown on three soils, Thomas sandy loam, Wisner clay loam, and Osh-temo loamy sand. The Osh-temo was limed to obtain three pH levels.

The amount of B extracted from soils by the five-minute boiling procedure was poorly correlated with the level of B in plants except in the case of the Thomas soil which was high in alkaline organic matter. The results indicate that repeated borax applications may not be required despite the fact that soils tests show a need for boron. The best test of the B-supplying power of soils is a plant tissue analysis.

When environmental conditions were constant, the B-supplying power of soil seemed to be a function not only of the equilibrium concentration of B in the soil solution but also of the rate of equilibrium establishment.

There was no correlation between yield or percent of Ca, Mg, K, P, or protein in alfalfa tissue and the concentration of B, when B levels varied between weak B deficiency levels and higher levels which did not include B toxicity. When B deficiency was severe, yield responses to borax were obtained. Mg, K, P, and protein were higher in severely deficient plants than in healthy ones, due probably to dilution in the healthy plants. Calcium was lower in severely deficient plants than in plants not B deficient, when Ca was in short supply.

West. Wash. Expt. Sta., Puyallup, Wash.

Harris, H. C., and Gilman, R. L. EFFECT OF BORON ON PEANUTS. *Soil Sci.* 84: 233-242. 1957.

Early Runner and Dixie Runner varieties of peanuts grown on Blanton fine sand responded to boron fertilization in greenhouse experiments in Florida but previous field experiments by others have shown little or no response of boron on yield or quality. The authors suggest these differences in results may be because of better control in the greenhouse experiments or to boron applied in fertilizers or lime used in field experiments.

Fla. Agr. Expt. Sta. Gainesville, Fla.

Amin, J. V., and Joham, H. E. A MOLYBDENUM CYCLE IN THE SOIL. *Soil Sci.* 85: 156-160. 1958.

The availability of soil molybdenum to cotton plants was studied on the basis of solubilities of the different oxides of molybdenum and the absorption of molybdenum by seedlings when supplied with these compounds. The highest oxide of molybdenum was found to be freely available, while little or no molybdenum in soil was classed into three fractions: (a) the water soluble, (b) ammonium hydroxide soluble, and (c) the oxidizable fraction. These fractions were noted to correspond closely to the solubilities of (a) molybdate salts, (b) molybdenum trioxide, and (c) reduced oxides of molybdenum in atta clay-molybdenum mixtures. A molybdenum cycle in soil based on the oxides of molybdenum was presented.

Texas Expt. Sta., Lubbock, Tex.

Wallace, A., Shannon, L. M., Lunt, O. R., and Impey, R. L. SOME ASPECTS OF THE USE OF METAL CHELATES AS MICRONUTRIENT FERTILIZER SOURCES. *Soil Sci.* 84: 27-41. 1957.

This paper summarizes the work of the University of California, Los Angeles, on reactions of chelates in soils and plants and on methods of application.

U. Calif., Los Angeles, Calif.

Kuykendall, J. R., Hilgeman, R. H., and Van Horn, C. W. RESPONSE OF CHLOROTIC CITRUS TREES IN ARIZONA TO SOIL APPLICATIONS OF IRON CHELATES. *Soil Sci.* 84: 77-86. 1958.

This paper reports field trials with NaFeDTPA, NaFeHEEDTA, HFeEDDHA, RA 157 Fe, and RA 159 Fe to determine their relative effectiveness in the correction and control of lime-induced iron chlorosis in Arizona citrus.

Rapid and essentially complete regreening of chlorotic leaves of lemon and orange trees growing on sandy soils on the Yuma Mesa and in the heavier silt and clay loam soils of the Salt River Valley was obtained with soil applications of HFeEDDHA at rates of 12 and 24 g. Fe per tree.

Less rapid but satisfactory regreening was obtained from RA 157 Fe at a rate of 48 g. per tree, and with NaFeDTPA at a rate of 96 g. per tree. NaFeHEEDTA at the rate of

164 g. Fe per tree gave very satisfactory regreening of chlorotic lemon trees on the sandy Yuma soils, but only irregular and partial regreening of chlorotic orange trees on the heavier soils in the Salt River Valley. Field response of NaFeDTPA and NaFeHEEDTA indicate that both iron chelates are probably adsorbed on the clay fraction of the heavier silt and clay soils on which citrus is grown in Arizona. This adsorption phenomenon makes these two chelates more slowly and difficultly available to citrus trees than the iron chelate HFeEDDHA which is not adsorbed on clays.

U. Ariz., Tuscon, Ariz.

Stewart, I., and Leonard, C. D. USE OF CHELATES IN CITRUS PRODUCTION IN FLORIDA. *Soil Sci.* 84: 87-97. 1959.

Iron chlorosis, one of the most difficult deficiencies to correct, has been successfully overcome by the use of iron chelates. In Florida nearly half the citrus groves have been found deficient in iron. It has been on these acid sands that FeEDTA has been very effective in alleviating the deficiency. FeEDTA is now a common component of many fertilizers used on citrus in Florida. The problem of correcting the deficiency has been much more difficult in calcareous soils because of the chemical properties of the chelates, but new chelates have been developed which are excellent sources of iron for plants growing in soils with a high lime content.

Zinc chelates have been studied rather extensively in Florida and some have been found to be much more available sources of zinc than inorganic forms in greenhouse soil cultures. Years of field trials, however, indicate that for citrus zinc chelates have few advantages over zinc sulfate as a source of this element.

Citrus Expt. Sta., Lake Alfred, Fla.

Benson, N. R., Batjer, L. P., and Chmelir, I. C. RESPONSE OF SOME DECIDUOUS FRUIT TREES TO ZINC CHELATES. *Soil Sci.* 84: 63-75. 1957.

Zinc deficiency in fruit trees in Washington is widespread and currently zinc sulfate sprays are the most effective correctant. A safer treatment is desired, thus the present investigation of zinc chelates.

Soil applications of zinc EDTA and zinc HEEDTA were made to zinc-deficient peach, sweet cherry, and apple trees. Deficiency was corrected on peach and sweet cherry trees, but not on apple trees. Uptake of zinc was also indicated by a higher zinc content in peach and sweet cherry leaves, but there was no significant increase in apple leaves.

These studies show that peach and cherry trees may be treated with a soil application of 1 to 2 pounds of zinc chelate per tree to help restore the trees to normal. It has not yet been determined how long an application of zinc chelate will maintain a peach or cherry tree. If repeat treatments are required at frequent intervals, the treatment may not be economically sound. No explanation can be offered for the failure of apple trees to respond to zinc chelates.

Wash. Agr. Expt. Sta., Pullman, Wash.

Anderson, M. S. COMPOST AS A MEANS OF GARBAGE DISPOSAL. *Proc., Fla. Soil and Crop Sci. Soc.*, 16: 134-145. 1956.

Composts made wholly or in part from garbage have been prepared in various places on an experimental basis and, to a limited extent as commercial products. It is not difficult to form compost from various organic materials, including garbage, but commercial production presents a variety of problems, only part of which have been solved.

Raw garbage differs in chemical composition, which accounts for wide variations in composts made from this source of organic material. Garbage composts from various parts of the United States have been analyzed, and their rates of nitrification determined. Nitrogen contents vary from 0.44 to 4.11 percent. Nitrification rates of garbage composts are very low. Large applications may, however, favorably affect the physical properties of soils. There appears to be no great difficulty in making garbage composts containing

between 1.2 and 2.5 percent of nitrogen. The plant-nutrient contents of garbage composts approximate those of farmyard manure.

Garbage composts may be useful in several ways: (1) in making potting soils, (2) as mulches, (3) for working into soils of various textures, and (4) for improving soils at the time of establishing lawns. When adequate local supplies are available, market gardeners may use these products instead of animal manures and other organics.

SWC, ARS, USDA, Beltsville, Md.

Structure Control

Elder, William R. SOIL COMPACTION ZONES AS AFFECTED BY CONSERVATION CROPPING SYSTEMS. *Soil Sci. Soc. Amer. Proc.* 22: 79-82. 1958.

The effect of soil compaction on rooting depth, aeration, and effects on erosion and drainage of Houston Black clay, a monotonous Grumusol are reported.

Field samples were taken over a broad area representative of definite nonconservation and conservation cropping systems. A single field was sampled on a sequence basis to measure the changes wrought by tillage from a perennial grass to a mature cotton crop.

Compaction zones were measured by the change in bulk density and structural index as compared to normal values of virgin soils or soils in good condition. Bulk densities and structural indices were determined by the use of nonpolar liquid.

Compaction zones were common under continuous row crop systems.

Compaction zones form rapidly as a result of poor soil management, even within a single cropping season following a 2-year period of perennial grass.

SCS, USDA, Temple, Tex.

Tanner, C. B., and Mamaril, C. P. PASTURE SOIL COMPACTION BY ANIMAL TRAFFIC. *Agron. J.* 51: 329-331. 1959.

Measurements of soil air permeability, penetrability to a sharp probe, aeration porosity and bulk density on several pastures indicate that almost all pasture soils suffer serious compaction by animal traffic. Only a coarse silt loam, which contained little clay and behaved mechanically much like a very fine sand, did not compact further under animal traffic. Measurements of alfalfa-brome-ladino yields, in which the effect of growth stage and cutting frequency were excluded, indicated that the compaction of an Ontonagon clay loam produced by pasturing for one summer may lower yields by 20%. Since this yield decrease occurred on a well managed pasture, the results imply that pasture management which permits grazing during and shortly following rains when the soil is plastic may affect yields greatly due to increased compaction of wet soil.

U. Wis., Madison, Wis.

Cooper, A. W., and Nichols, M. L. SOME OBSERVATIONS ON SOIL COMPACTION TESTS. *Agr. Engin.* 40: 264-267. 1959.

Mechanization in agriculture has been a major factor in the advancement of civilization in the twentieth century. However, this rapid development and extensive use of larger power units and equipment has brought, along with its benefits, economic and physical problems of land and soil management which require for their complete solution the combined efforts of many branches of science. While recognizing the importance of management, physical and biological problems, the observations in this paper are directed primarily toward the effects of implements and traction on soil compaction.

The authors review 27 published articles on compaction and compaction tests. A field dynamometer to test subsoilers under field conditions is described.

Natl. Tillage Mach. Lab., USDA, Auburn, Ala.

Rennie, P. J. ROUTINE DETERMINATION OF THE SOLIDS, WATER, AND AIR VOLUMES WITHIN SOIL CLODS OF NATURAL STRUCTURE. *Soil Sci.* 84: 351-365. 1957.

A procedure is described suitable for routine determination of the solids, water, and air volumes contained within soil clods from agricultural, forest, and moor soils.

The procedure is based on Russell, Balcerk and Boyanoff's kerosene impregnation method. After naturally structured clods of field wetness are cut from the soil horizons to be examined, they are weighed, immersed in kerosene, and subjected to reduced pressure and soaking treatments which quantitatively replace their air by kerosene. By then weighing the clods in kerosene, in air, and again in air after the removal, by oven-drying, of all kerosene and water, and by subsequently grinding the dried clods, the proportions of stone, fine earth, water, and air in the clods and their apparent and real densities can be calculated.

Critical steps in the procedure are examined and discussed with particular reference to its suitability for different soils, and brief examples illustrate the value of the data obtainable.

Imperial Forestry Inst., Oxford, Eng.

Smith, R. M. SOIL STRUCTURAL EVALUATIONS WITH A NONPOLAR LIQUID. *Soil Sci.* 84: 311-320. 1957.

Various methods and procedures for soil structural characterization are discussed. The author concludes that at least three deficiencies of such methods are apparent. First, most of the methods are designed or adapted for measurement of a single physical phenomenon. Second, many of the techniques are rather cumbersome or require specialized equipment and thus are not readily adapted to extensive applied use. And third, sampling for many of the determinations is difficult because of the inherent physical nature of certain soils. The present study attempted to devise and calibrate simple tests that would help to measure and interpret soil structural differences that occur primarily in heavy-textured, calcareous, high-shrinking soils, with which many standard tests are unsatisfactory. Soil porosity, structural index, and transmission rate determinations have been made using a nonpolar liquid, Varsol. The pore space and structural index methods may be used with any convenient size or shape of lump. This is especially convenient with heavy clay soils from which satisfactory undisturbed soil cores cannot be obtained.

ARS, USDA, Tex. Agr. Expt. Sta., College Station, Tex.

Mathieu, A. L., and Toogood, J. A. A SELF-RECORDING SOIL PENETROMETER. *Canada J. Soil Sci.* 38: 100-102. 1958.

A new model of a recording penetrometer to measure soil compaction and consistency is described. It differs from previous penetrometers in its controlled rate and depth of probe penetration and in the ease with which replications can be made. It has been developed for field use to enable many recorded readings to be taken conveniently in a short time.

U. Alberta, Edmonton, Alberta, Canada.

Drainage

Saveson, Irwin L. LAND FORMING FOR DRAINAGE. *Agr. Engin.* 40: 208-209, 213. 1959.

The presence of ponded water in pockets on land after heavy rains is indicative of an unsmooth surface which takes its toll in lowered crop production. The primary purpose of forming and smoothing land is to provide a uniform land surface that will facilitate an even movement of surface water over the entire fill. The practice was developed in the arid section of the United States to assist in the application of irrigation water, and it is

moving to the humid section of the country to facilitate removal of excess rainfall by surface drainage, especially in Louisiana, where the annual rainfall is very high, ranging from 55 to 60 in.

Research work was started in Louisiana in 1946. This modification of land forming, called in the sugar-cane area "turtlebacking," is becoming more popular on sugar plantations.

Recently a modification of turtlebacking has been used in the cotton and general crop section of the Louisiana Delta. Under these conditions, it facilitates both the application and removal of surface water for irrigation and drainage. Agricultural workers have used the principles and techniques developed in the arid section of the United States in forming and smoothing land since there was little information available for the humid areas, but due to climate, crops, topography, and soils, have found it necessary to modify them to meet conditions of the humid area.

Land forming to improve drainage in Louisiana can be divided into three classes: sugar cane land, pasture land, and general cropland.

Sugar cane land is divided into cuts from 150 to 250 ft. wide and approximately 1,000 ft. long, bounded by a drainage ditch on each side and a headland across each end.

Pasture land is generally formed into beds or corrugations with a limited amount of surveying and staking. In most instances the beds or corrugations are approximately 60 ft. wide. Each bed has a flat-sloped ditch (6:1) on each side which blends into the bed or the corrugations to facilitate mowing.

The forming of general cropland requires more surveying and staking than sugar cane or pasture land since it consists of large areas. It will require a topographic map for earth-moving design and calculations.

Ripping the area after smoothing to remove the compaction caused by the earth-moving machines is desirable. These machines increase the bulk density of the fill areas by approximately 0.10 grams per centimeter (approximately 6-1/4 lb per cu ft.). It is also desirable to rip the area for blending of the fill with the original soil and thus lessen the crop retardation in the fill areas. A heavy field cultivator with flexible chisel shanks is a good tool for this operation.

ARS, USDA, Baton Rouge, La.

Nathan, Kurt. STUDIES AIMED AT IMPROVING TILE DRAINAGE ON N. J. FARMS.
N. J. Agr., 41 (3): 4-6. 1959.

Over 3 million feet of drainage tile has been installed in New Jersey. Average cost for installation, including the cost of tile, was found to be 26 cents per foot for the 4 inch tile and 37 cents per foot for 6-inch tile. In order to get the most economical use out of each dollar invested, it is essential that the size of tile, the spacing between the line and the depth of the tile be properly determined for each system according to the specific soil and drainage characteristics in a field.

A study is under way to answer some of the questions on proper installation. Piezometers were placed in sets of 6 at depths of 1, 1-1/2, 2, 2-1/2, 3, and 3-1/2 feet below the ground surface; over the tile, 3, 8, 18, 30, and 50 feet to either side of the tile. By periodically measuring the water in these piezometers it was possible to follow the movement of the free water. The maximum daily average flow was in excess of 75 gallons a minute, but rates as high as 115 gallons per minute were reached for shorter periods.

On Fallsington silt loam the drawdown between the tile lines which were spaced 100 feet apart, showed a maximum drop of 2.3 feet in 24 hours where the tile was placed 3.2 feet deep.

On Dolonton sandy loam the maximum drop was only 4 inches in 24 hours. The spacing of the laterals here is also 100 feet, but the depth is 2.6 feet.

Col. Agr., Rutgers U., New Brunswick, N. J.

Talsma, T., and Flint, S. E. SOME FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF SUBSOILS WITH SPECIAL REFERENCE TO TILE DRAINAGE PROBLEMS. *Soil Sci.* 85: 198-206. 1958.

An investigation of the hydraulic conductivity of subsoil materials below a depth of about 3 feet was made in the Murrumbidgee Irrigation Areas of New South Wales. Soil texture was found to be the most important property of determining hydraulic conductivity. Correlations of hydraulic conductivity with percentage clay and percentage clay plus silt are highly significant.

In materials of similar texture hydraulic conductivity was found to decrease with depth below the surface. This phenomenon is relatively most pronounced in materials of heavy texture and is only slight in materials of very light texture. Compaction of the deeper layers by the overlying material is considered the main reason for this decrease.

Irrig. Res. Sta., Griffith, N. S. Wales.

Ede, A. N. THE HYDRAULIC COMPARISON OF LAND DRAINS AND THE DETERMINATION OF EFFECTIVE DIAMETERS. *J. Agr. Engin. Res.* 3:9-16, 1958.

A hydraulic sand tank method has been used for making rapid ad hoc comparisons between various drain installation types. By subjecting to test a series of ideal drains of various diameters the function of diameter in controlling performance under known boundary conditions has enabled its performance to be matched with that of an ideal drain of certain diameter, a relation which does not appreciably vary with the operating conditions. The relative discharge data for variously gapped, spaced and perforated drains are presented. The broad effect on drainage design is discussed.

School of Agr., U. Cambridge, Cambridge, Eng.

Harrison, D. S., and Weaver, H. A. SOME DRAINAGE CHARACTERISTICS OF A CULTIVATED ORGANIC SOIL IN THE EVERGLADES. *Soil and Crop Soc. of Fla., Proc.* 18: 184-192. 1958.

Water control has always been a problem for Everglades farmers. The elevations of the organic soils within the agricultural region are 11.5 to 13.0 feet above m.s.l. Water movement over the surface is considered poor, while water movement through the soil has been considered poor to fair. After extensive drainage and cultivation practices for a number of years, downward movement of soil water is generally considered to be reduced. This is especially the case after many years of cultivation wherein the organic matter content has decreased. The soil loses its fibrous nature and becomes compact as it breaks down into smaller particles.

Present research at the Everglades Station in the field of drainage has been directed toward studying the drainage characteristics of the different types of organic soils. The purpose of these studies is to determine optimum horizontal spacing of mole drains. Both field and laboratory tests on drainage rates were made. This is a progress report of one year's work on Everglades peaty muck following one year of cultivation and one year under pasture management.

SWC, ARS, USDA, Fla. Agr. Expt. Sta., Gainesville, Fla.

Klingelhofer, Karl R. FARM DRAINAGE BY PUMPING. *Agr. Engin.* 39: 754-757. 1958.

There are many acres of wet but potentially good cropland in Michigan that are not fully utilized for lack of good natural, gravity drainage outlets. Some of the acreage has not been farmed recently; some has been left undrained for various reasons and in other areas recent drainage improvements have been limited. It is estimated that there are approximately 400 pumping plants in operation draining 45,000 acres, of which 12,500 acres are drained by two plants. Approximately one-third of the total area requires only pumping of tile drainage water. The other two-thirds requires pumping of both tile and surface water.

SCS technicians in Michigan have assisted many farmers on the design of the farm pumping plants. Usually these jobs involve the installation of a pumping station to improve existing drainage outlets on land that has been under cultivation for some time but with limited returns. Frequently pump drainage allows a farmer to establish a conservation rotation on land that was previously subject to spring flooding or at least very poor internal drainage. Before pump drainage, the farmer would gamble on the weather and plant short season cash crops each year with harmful effects to soil structure.

Area Engin., SCS, East Lansing, Mich.

Irrigation

Lauritzen, C. W., and Haws, Frank W. ASPHALT-BURLAP LININGS FOR CANALS AND RESERVOIRS. *Agr. Engin.* 40: 340-342, 344. 1958.

There is a real and ever-increasing need for lower cost canal and reservoir linings. A lining which is low in cost in one area, however, may be high in cost in another, depending upon site conditions and the availability of materials. It is doubtful if any one type of lining will ever be developed which will be superior under all conditions.

Asphalt is one material which offers attractive possibilities for lining construction. The investigations of asphalt as a lining material, however, have indicated some serious limitations. One of these has been the rapid deterioration of exposed asphalt. To overcome this problem, a buried asphaltic membrane was developed by the U. S. Bureau of Reclamation. Buried membranes of all types have the disadvantage that the lined perimeter must be considerably greater to have the same capacity as a canal with an exposed lining. Repairs are also difficult to make and stream velocities must be restricted greatly. The search, therefore, was continued for a low-cost exposed membrane lining. The built-up lining described offers possibilities of at least partially meeting this need. It is not known just how long this lining will last, but where properly installed, it is expected to last for some time. A feature of this lining which makes it attractive is the possibility for reconditioning it. It is anticipated that after a time, possibly 5 to 10 years, the surface of the lining will have deteriorated to a degree. When that time comes, it is proposed to apply a light application of asphalt to the surface, add another layer of burlap and a final light application of asphalt with the expectation that the reconditioned liner will be essentially as good as new.

Utah Agr. Expt. Sta., USDA, Logan, Utah.

Gingrich, J. R., and Russell, M. B. A COMPARISON OF EFFECTS OF SOIL MOISTURE TENSION AND OSMOTIC STRESS ON ROOT GROWTH. *Soil Sci.* 84: 185-194, 1957.

Comparisons of growth responses of corn roots to 7 soil moisture tensions and osmotic stresses, each in combination with 5 oxygen concentrations, were made by growing small seedlings for 24 hours at 25° C. in soil and in osmotic pressure media. In the absence of other limiting factors radicle elongation and the increase in fresh weight and hydration of the excised seedlings decreased with increasing soil moisture tension or osmotic stress over the 1/3- through 12-atmosphere range. The increase in dry weight of the excised seedlings also became progressively less as the soil moisture tension increased from 1/3 through 12 atmospheres but was unaffected by osmotic stress even when oxygen was not limiting. Root growth was usually greater when growth occurred in osmotic media than when it occurred in soil at moisture tensions of equivalent stress. The effect of oxygen concentration on the measured growth properties depended greatly on the moisture stress of the medium in which growth occurred. Because of the differences in growth between the two types of stress, some factor other than the straight physio-chemical effect of stress was believed to be operative. In view of the well-established concept of the influence of soil moisture tension on the ability of unsaturated soil to transmit water, these differences are believed to be associated with the water-transmitting characteristics of the two media.

Vt. Agr. Expt. Sta., Burlington, Vt.

Stanhill, G. THE EFFECT OF DIFFERENCES IN SOIL-MOISTURE STATUS ON PLANT GROWTH: A REVIEW AND ANALYSIS OF SOIL MOISTURE REGIME EXPERIMENTS. Soil Sci. 84: 205-214. 1957.

The question of whether soil water between field capacity and permanent wilting point is equally available to plants for growth has been disputed for nearly thirty years. The results of 80 papers listed show that, in over 80-per cent of the experiments, growth was affected by differences in the amount of available water depleted before the soil was re-wetted.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, Eng.

Bondurant, J. A. DEVELOPING A FURROW INFILTROMETER. Agr. Engin. 38: 602-604. 1957.

The furrow infiltrometer was tested by comparing the infiltrometer data with infiltration data obtained from field irrigation trials by using inflow-outflow measurements. Field measurements were made on four-row plots which included two furrows in which the infiltrometers were placed. The objective was to obtain a better measure of the infiltration rate of irrigated furrows than has been possible with previous infiltrometers.

This infiltrometer provides a means of measuring furrow infiltration rates when field measurements by irrigation trial are not feasible.

U. Nebr., Lincoln, Nebr.

Bouwer, H. INFILTRATION PATTERNS FOR SURFACE IRRIGATION. Agr. Engin. 38: 662-664, 676. 1957.

A method is presented whereby water absorption patterns for border or furrow irrigation systems are evaluated from a limited number of relatively easy-to-take field measurements. The method can be employed in the evaluation of surface irrigation systems or in studies to determine the effect of certain factors on infiltration behavior of relatively large areas under field conditions.

Ala. Polytech. Inst., Auburn, Ala.

Phillips, Richard L. LAND LEVELING FOR DRAINAGE AND IRRIGATION. Agr. Engin. J. 39: 463, 465, 470. 1958.

Land leveling to provide, in one system, both surface drainage and surface irrigation of Missouri River bottom land gives farmers double insurance against the hazards of either a wet or a dry year.

Design criteria used are discussed and the methods used by the United States Soil Conservation Service in designing the layouts are given. Yields of corn on two farms under irrigation have been measured at 135 bu/a. The systems will be used in the spring for drainage and in July and August for irrigation. It is the general belief of most farmers that they will be irrigating 9 out of 10 years.

Area Engineer, SCS, Council Bluffs, Iowa.

Lanham, W. J. ECONOMICS OF SUPPLEMENTAL IRRIGATION IN SOUTH CAROLINA. A PROGRESS REPORT. S.C. Agr. Expt. Sta. AE 160, 39 pp. November 1958.

On the 142 farms located in two areas (the Upper State and the Lower State), peaches, tobacco, cotton, corn, alfalfa, and pasture were irrigated. The study was made in 1956 and 1957. Comparative yields and returns of irrigated and nonirrigated crops during the 2 years indicate the profitability of irrigating the crop studied. Farmers reported increased net returns from irrigation of peaches of approximately \$300 per acre irrigated.

Increases in net returns from irrigation of other crops averaged considerably lower, but irrigation was still profitable when increases in net returns ranged from \$30 to \$60 per acre irrigated.

S. C. Agr. Expt. Sta. Clemson, S. C.

Thorfinnson, T. S., Hunt, M., and Epp, A. W. COST OF DISTRIBUTION OF IRRIGATION WATER BY DIFFERENT METHODS. Nebr. Agr. Expt. Sta. B. 432. August 1955.

Data for the study reported here was obtained from 26 farmers who irrigated with siphon tubes, 24 who used gated pipe, and 26 who had sprinkler systems.

These farms were located in the Hastings soil areas in York, Polk, and Hamilton Counties and the Crete soil areas in Fillmore, Clay, and Adams Counties, Nebraska. The methods of irrigation differed as to amount invested in equipment, labor needed for operating, cash operating costs, and amount of land grading required. Average investment in irrigation equipment per acre irrigated was \$11 for the siphon tube method, \$46 for gated pipe, and \$67 for sprinklers.

Number of man-hours of labor required for one irrigation per acre of corn was \$0.90, \$0.71, and \$1.41 for the 3 methods, respectively. Costs of operation were lowest for siphon tubes and highest for sprinklers. The largest item of operating cost for sprinklers was that of putting pressure in the sprinkler line. The cost of grading the land for irrigation is not included in operating costs. Grading is not required when sprinklers are used and this saving would offset to some extent the higher cost of operating the sprinkler equipment. In many instances, the cost of grading would be less for gated pipe than for siphon tube irrigation. If the costs of grading are prohibitive or if grading is not feasible, sprinkler irrigation may be the only method possible. If very little grading is needed, the siphon tube method may be most economical.

Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Tramel, T. E., Crowe, G. B., and Abel, J. F., Jr. SUPPLEMENTAL IRRIGATION, INVESTMENT AND OPERATING COSTS IN THE DELTA AREA OF MISSISSIPPI. Miss. State U. Agr. Expt. Sta. B. 559. May 1958.

Supplemental irrigation has received increased attention as a production practice in the Delta of Mississippi in recent years. In many instances, use of the practice has been based on a costly "trial and error" approach. This study was designed to give some insight into the cost of developing sources of irrigation water and to compare investment and annual operating costs for alternative methods of distributing water.

When natural surface sources of water are conveniently located and properly used, they are cheaper than wells as a source of irrigation water. However, the dependability of a surface source of water is often an open question. Wells in the Delta area offer a dependable and fairly cheap source of irrigation water. It is possible to develop and equip a well delivering 2,000 gallons of water per minute for approximately \$5,000. Annual pumping costs for a well could be expected to average around \$0.45 per acre-inch. For smaller wells, these pumping costs will increase; they may go as high as \$1.00 per acre-inch. For large wells--those in the neighborhood of a pumping capacity of 2,500 gallons per minute, annual costs range from 25 to 35 cents per acre-inch.

Based on the 145 farms included in the study reported here, investment in irrigation equipment averaged \$73 per acre irrigated for sprinkler systems, \$57 for gated-pipe systems, \$36 for siphon-tube systems, and \$50 for other gravity systems. Average investment for the 145 farms was \$56 per acre irrigated.

Annual operating costs per acre irrigated averaged as follows: Sprinkler systems, \$18; gated-pipe systems, \$18; siphon-tube systems, \$8; and other gravity systems, \$12. Average annual costs for all systems amounted to \$15 per acre irrigated.

Miss. State Agr. Expt. Sta., State College, Miss.

The irrigation of vegetables, nursery crops, and flowers has been common in Illinois for many years. Recently, interest in the practice has increased, especially for use with field crops. From 240 usable questionnaires of a total of 532 mailed, it was found that 141 farmers began to irrigate from 1954 to 1956 compared with 99 in 1953 and before. The number of new irrigation systems reached a peak in 1954 and declined slightly in 1955 and 1956. In addition to vegetables, flowers, nursery crops, small fruit, and orchard crops, such field crops as corn, soybeans, barley, oats, wheat, hay, and pasture were irrigated. Acreages irrigated averaged 82 acres per farm for 95 farmers who raised field crops and pasture compared with 24 acres for 129 producers of specialty crops. The largest irrigated acreage was of corn. In 1956, the largest concentration of specialty crops was in the Chicago-Kankakee area; that of field crops was in Pike, Adams, Hancock, and Henderson Counties.

Most of the irrigation was on sandy or silt loam soils or a combination of these two types. Sprinkler irrigation systems of portable pipe and sprinklers were used almost exclusively. The chief source of power for pumping water was the internal combustion engine, followed by electric motors and combinations of the two. Most of the irrigators were owners or part-owners. Census survey records for 1955 showed that total investment in irrigation equipment alone ranged from \$1,028 for 21 farmers who irrigated an average of 4 acres to \$12,000 for 3 farmers who irrigated an average of 125 acres. Farmers were better satisfied with irrigation of specialty than with field crops and pasture. The most satisfactory crop irrigated was the strawberry crop, while corn was the least satisfactory.

Ill. Agr. Col., Urbana, Ill.

Hughes, W. F., Magee, A. C., Jones, Don, and Thaxton, E. L., Jr. ECONOMICS OF WATER MANAGEMENT FOR COTTON AND GRAIN SORGHUM PRODUCTION, HIGH PLAINS. Tex. Agr. Expt. Sta. B. 931, 17 pp., illus. May 1959.

Operators may follow four alternative water-management systems if they prepare for them in advance. With system 1, which uses the smallest amount of water, only cotton is irrigated after August 1. With system 2, which uses a little more water than system 1, a full-season hybrid sorghum is the only crop irrigated after August 1. System 3 combines the cotton-irrigation program of system 1 with irrigation of sorghum hybrids planted about July 1. In system 4, the first water application on the full-season sorghum hybrids is made as in system 2, after which the water is shifted to the late-planted sorghum hybrids. Systems 3 and 4, which are the heavy water users, should not be used regularly. Because of competition for water during the first 2 weeks of August, independently developed cotton and grain sorghum irrigation practices that maximize yields cannot be combined advantageously on the same farm.

Planting 1 acre of cotton to 1.75 acres of grain sorghum permits operators to use the most advantageous water-management system on August 1. The system that is more profitable with a head of 135 gallons per minute is also most profitable with a head of 540 gallons per minute. Based on 1946-56 average prices received for cotton lint, cottonseed, and grain sorghum, water-management system 2 is most profitable. With this system and these prices, the tenant's annual residual return to water from a typical 320-acre farm would be \$22.15 per acre. The return to the landlord would be \$14.40 per acre. The breakover price for water would be about \$38.00 per acre.

Tex. Agr. Expt. Sta., College Station, Tex.

Hughes, W. F., and Magee, A. C. COSTS AND RETURNS OF IRRIGATED PEANUT PRODUCTION, WEST CROSS TIMBERS, 1953-57. Tex. Agr. Expt. Sta. B. 917, 10 pp., illus. September 1958.

Five years of experience on five farms in the Highlands Community of Comanche and Erath Counties showed that wells of low capacity - 25 to 120 gallons per minute (g. p. m.) - can be used profitably in production of irrigated peanuts. The small heads of water combined

with the types of equipment needed result in an irrigation development cost that ranges from \$146 to \$301 per acre irrigated on individual farms. Irrigation of peanuts means heavier seeding rates, more hoeing and cultivation, and additional harvest costs. Additional labor is needed to lay out, move, and retrieve sprinkler systems.

From 1953 to 1957, irrigation of peanuts made a 20-bushel difference in yield and improved the quality of the peanuts, especially in the dry years of 1954 and 1956. Hay yields were increased by about 20 bales per acre. Costs for irrigation water averaged \$5.09 per acre-inch, or \$33 per acre. Cost of labor averaged \$13.66 per acre, and the average total cost of irrigation, including operating and overhead, averaged \$46.64 per acre of irrigated peanuts. The 5-year average net return from irrigated peanut production ranged from \$39.65 to \$59.64 per acre for the 5 farms but varied considerably among farms and on the same farm in different years. The lowest net return was \$10.25 per acre and the highest \$196.40, both on the same farm. The 5-year average annual return to investment per farm from irrigated peanut production ranged from 18.9 to 33.4 percent.

Tex. Agr. Expt. Sta., College Station, Tex.

Sitler, H. G., and Rehnberg, R. D. NORTHEASTERN COLORADO IRRIGATED PASTURES . . . COST AND PRODUCTION. Colo. Agr. Expt. Sta. and Ext. Serv. B. 437-A. November 1954.

Advantages of using irrigated pasture in fattening beef were cheaper gains, less labor needed, distribution of manure, and no shelter required. Disadvantages included less labor available to care for livestock in summer than in winter, the high price of feeder cattle in spring, possible low gains because of drought, flies, or heat, and the difficulty of providing shade and water. The problem of bloating of animals was also present and preventive measures were used. On the whole, the advantages outweighed the disadvantages. This information was obtained from more than 100 farmers in northeastern Colorado who had irrigated pastures. Each farmer was interviewed twice a year in 1940, 1951, and 1952. It was found that it takes an average of 6-1/2 man-hours of labor and a total cost of around \$50 at 1950 prices to establish an acre of irrigated perennial pasture in this area. When a companion crop (barley) was added and the field grazed during the year it was seeded, the cost was only \$17.86. Annual cost of maintenance per acre was \$30.50. Adding a 5-year depreciation cost on establishment brought the total to \$34.07. Net cost of grazing per head per month was \$2.90 for dairy cows; \$1.90 for beef-fattening steers; \$1.75 for breeding cows; and \$1.10 for sheep. Application of nitrogen fertilizer and the practice of clipping benefited the pastures, as did phosphate fertilizer and harrowing used together. Economic returns from irrigated pasture increased up to the fifth year after which they gradually decline. From 4 to 7 years of use give the greatest returns. It was found that irrigated annual pastures could be established at less cost than irrigated perennial pastures.

Colo. Agr. Expt. Sta., Fort Collins, Colo.

Taylor, Sterling A., Haddock, Jay L., and Pedersen, Marion W. ALFALFA IRRIGATION FOR MAXIMUM SEED PRODUCTION. Agron. J. 51: 357-360. 1959.

A range of optimum soil moisture for production of alfalfa seed was clearly found. Seed yields were maximum when the equivalent mean soil moisture suction was between 2 and 8 bars. In contrast, the yields of alfalfa forage did not exhibit such an optimum, but the yields continued to increase as the equivalent mean soil moisture suction decreased to approximately the value it had at field capacity.

Highest seed production was obtained by keeping the soil continually moist, as indicated by low soil moisture suction, at all times from the initiation of growth in the spring until beginning of blossoming, then withholding water and allowing the moisture suction to increase with usage of stored soil water. The soil reached the 15 bar suction value to a depth of 6 feet just before the seed was harvested. Reduced yields of seed were observed if plots were irrigated during blossoming. If moisture was reduced to the fifteen bar suction value much before harvest time by withholding water too early, yields were also retarded.

Utah State U. Logan, Utah.

This bulletin gives the results of studies conducted for several years at Lubbock and Tulia on the use of irrigation water by cotton. Cotton yields in pounds of lint per inch of water were about the same for all moisture levels studied. In general, the high moisture levels are the most profitable. If the supply of water is short, no significant loss will occur in yield per acre-inch of water by following any one of the treatments studied. Cotton uses varying amounts of water efficiently, which makes it an easier crop to irrigate than grain sorghum. The preplanting irrigation is the most important one.

Tex. Agr. Expt. Sta., College Station, Tex.

Erosion Control

Meyer, L. Donald, McCune, Donald L. RAINFALL SIMULATOR FOR RUNOFF PLOTS. Agr. Engin. J. 39: 644-648. 1958.

A portable rainfall simulator developed at Purdue University produces artificial storms of approximately the kinetic energy of high intensity natural rainfall. The simulator is used to compare the soil loss, water loss, and infiltration rates of treatments on standard-size rectangular runoff plots.

Simulated storms may be applied to treatments being studied under any condition at any time and as often as desired throughout the year, except on tall crops and during freezing weather.

Factors well suited to tests with the simulator include: soil erodibility, length of slope, percent of slope, part erosion, crop cover at various stages of growth, rotations, fertility level, tillage practices, and residue management.

Soil and water loss evaluations by natural rainfall usually take 10 to 25 years - yet it is often vital to have such information much sooner. The rainfall simulator frequently makes more rapid evaluations possible.

Agr. Expt. Sta., Purdue U. Lafayette, Ind.

Hursh, Charles R. MR. KAWABATA'S PLANTING BRICK. J. Soil and Water Conserv. 13: 76-77. 1958.

Planting bricks, 10x8x1-1/4 inches, were made of enriched soil and chopped straw and pressed into a light block, with depressions on the top surface for the seed. Seed then is brushed into these depressions and is held in place with a protecting coat of clay and mud. The bricks can be made in advance or manufactured directly in the field. The only general requirements for bricks is that the mixture will hold together well after coming out of the press.

The best success has been obtained in Japan by setting the planting bricks very early in the year, but the bricks have been set during all seasons of the year.

The planting brick was designed for erosion control on bare steep sites. It has been used successfully for protecting road and river banks, earth dams and reservoir shore lines. In addition it has been used for range betterment and for growing barley and wheat on particularly poor sites.

U. Tokyo, Tokyo, Japan.

Woodruff, H. P., and Chepil, W. S. IMPLEMENTS FOR WIND EROSION CONTROL. Agr. Engin. 37: 751-754. 1956.

Tillage equipment that will prove most effective in the prevention and control of wind erosion is that which will do a good job of creating a cloddy soil surface and at the same time avoid burying the crop residue.

Western Soil and Water Mangt. Res. Br., ARS, USDA, Fort Collins, Colo.

This paper presents recent developments which add to the research information currently available to serve as a basis for factors comprising the soil-loss estimating equation.

The exponent for length of slope in the soil-estimating equation was analyzed on the basis of 532 plot-years of data assembled at the central soil and water loss data statistical laboratory at Lafayette, Ind. The magnitude of the exponent varies considerably from year to year as well as between locations. It appears to be affected by an interaction effect of slope length and soil type on runoff. In the North Central and northeastern states 0.5 appears to be a good conservative estimate of the over-all average value for the length exponent.

The percent slope-soil relationship should be studied in new field tests without contouring, on as many as physically possible. Very limited available data indicate a parabolic relationship for slopes under 20 percent. However, it is quite possible that the shape of this curve was influenced by the fact that most of the data are from plots with cultural operations on the contour. The effectiveness of contouring is generally considered to be a function of percent slope.

A family curves in Fig. 1 presents the appropriate factors for adjusting soil-loss data for differences in length and degree of slope.

A single-storm, two-equation approach to soil loss prediction is presented as a means of minimizing bias in soil loss data due to significant differences in the characteristics of individual rains. Extensive analyses of fallow-plot data to evaluate the effects of rainstorm characteristics on soil and water loss yielded a new rain parameter which appears to be quite efficient as a basis for classification of storms according to erosion-producing potential. The parameter is the product of the rainfall-energy values associated with rainfall intensities is presented to facilitate computation of the new parameter.

Soil erodibility and rainfall factors may be evaluated independently by employment of the new relationships provided to segregate soil and rainfall effects. This greatly enhances the utility of plot data in geographic regions other than where the field studies were conducted. The procedure is illustrated in a partial study in which erodibility factors for four soils and rainfall factors for four locations are numerically evaluated.

SWC, ARS, USDA, Beltsville, Md.

Barnett, Aurelius P. HOW INTENSE RAINFALL AFFECTS RUNOFF AND SOIL EROSION. Agr. Engin. J. 39: 703. 1958.

Easily measured rainfall characteristics were correlated with erosion from 98 selected intense storms in an effort to derive a usable mathematical relationship that would express with an acceptable degree of accuracy the expected erosivity of individual intense storms.

Factors studied in relation to erosion were rainfall; amount, duration, maximum 5, 10, 15, 30, and 60-min. Intensities, and time of occurrence, runoff, and antecedent soil moisture.

No single rainfall characteristic or combination of characteristics of those studied was found which would serve to adequately predict the expected erosion from a given storm for the conditions studied.

The maximum 60-min. rainfall intensity was found to be the single factor most closely related to erosion. The linear regression equation for erosion and 60-min. intensity was $E = 3.33X - 0.73$.

When the 60-min. intensity equation was applied to all runoff producing storms over the 12-year period, 1940-51, the average annual estimated erosion was 44 percent above the actual average. The average annual erosion measured 20.46 tons per acre, while the amount estimated by the Formula, $E = 3.33X - 0.73$, was 29.34 tons per acre.

So. Piedmont Expt. Sta. and Res. Asso., Col. Expt. Sta. U. Ga., Athens, Ga.

Smith, D. D., and Wischmeier, W. H. FACTORS AFFECTING SHEET AND RILL EROSION. Amer. Geophys. Union Trans. 38: 889-896. 1957.

This paper discusses the two principal processes by which sheet erosion occurs and the six factors which effect the magnitude of the losses. The processes are raindrop impact and transportation of soil particles by flowing water. The factors are length and per cent slope, cropping soil, management and rainfall. The relative effectiveness of each of the three main conservation practices in control of erosion, contour farming, strip cropping, and terracing is presented. The factors and practices are combined in a rational erosion equation for calculating field soil loss for use in application of conservation practices and in assessing land program benefits.

SWC, ARS, USDA, Beltsville, Md.

Woodruff, H. P. WIND-BLOWN SOIL ABRASIVE INJURIES TO WINTER WHEAT PLANTS. Agron. J. 48: 499-504. 1956.

Winter wheat plants were given fall and spring exposures to blowing soil in a wind tunnel. Average yields, weights of plant material, and number of heads for spring treatments were 46.4, 29.4, and 23.9 per cent less, respectively, than fall treatments. Heading and ripening of grain were delayed 1 week to 10 days in severely exposed plants. The total amount of soil striking a plant was more important in depressing products of plant growth than was the length of time between exposures. The plants were shown to have remarkable recovery powers if given water after severe abrasive injury.

West. Soil and Water Mangt. Res. Br., ARS, USDA, Fort Collins, Colo.

Adams, J. E., Henderson, R. C., and Smith, R. M. INTERPRETATIONS OF RUNOFF AND EROSION FROM FIELD SCALE PLOTS ON TEXAS BLACKLAND SOIL. Soil Sci. 87: 232-238. April 1959.

Runoff and erosion data from field-scale plots over the last 5 years show that land in a row crop following close-drilled or broadcast crops of oats with sweetclover or fescuegrass with sweetclover has been significantly less erodible and has had less runoff than continuous row-crop land. This reduction in runoff and erodibility (soil loss per inch runoff) may be the result of surface residues left by trash-mulch procedures and by altered soil physical conditions. No difference in soil loss was noted at this location for row crops following broadcast crops or close-drilled crops prior to the present cropping systems which are managed by sub-surface tillage methods.

Field measurements of runoff and erosion made with a portable rainfall simulator showed a significant difference in water loss and runoff erosion between the row-crop phase of a corn-fes-fes-system and continuous row crop, but none between corn-oat system and continuous row crop. General agreement between rainfall simulator and field plot data indicate that the rainfall simulator may have promise in evaluating the relative influence of cropping systems and management on water intake and soil erodibility.

Annual runoff and erosion has usually been low from oats, fescuegrass, and sweetclover plots.

The effect of moisture content upon aggregate stability may account for some of the high soil losses observed for intense rains falling on dry soil. Rapid wetting of the dry surface soil causes the aggregates to disintegrate, covering the surface with loose, fine material that reduces infiltration and is easily transported by runoff water.

Moisture content of Blackland soil at the time of rainfall has an obvious effect on water intake from the standpoint of water-storage capacity. In addition, soil moisture affects shrinkage and crack development, water movement, and aggregate stability.

In general, soil and water losses from the field-scale plots can be interpreted, for the present cropping systems, on the basis of soil moisture depletion during dry periods, and on the basis of surface residues and the physical condition of the soil during wet periods.

Tex. Agr. Expt. Sta., and Blackland Expt. Sta., Temple, Tex.

Hauser, Victor L., and Allen, Ronald R. RUNOFF MEASURED ON SILTY CLAY LOAM SOILS ON THE HIGH PLAINS OF TEXAS. Prog. Rpt. 2098, Tex. Agr. Expt. Sta. Tex. A&M., 3 pp. 1959.

A study of runoff from Putman silty clay loam was made in the semi-arid area in the Texas High Plains. Mean annual precipitation ranged between 17 and 20 inches per year.

Dryland crop yields in this area usually are limited by drouth. The magnitude and rate of surface runoff from cultivated land should be known to design terrace systems, cropping sequences and soil management procedures which can better utilize available precipitation.

Results of the first year of runoff measurements made during the calendar year 1958 at the Southwestern Great Plains Field Station, at Bushland, are included in this report.

Runoff was measured from three adjacent fields that had a surface slope of about 1.8 percent.

Runoff water was caught by graded terraces and measured by concrete type "H" flumes built at the outlet end of each terrace. The terrace channels have a uniform grade of 0.1 foot per 100 feet, and range in length from 1,650 to 2,000 feet. No depressions exist to cause permanent channel storage. The terraces are built on about a 2.5-foot vertical interval.

The fields are managed in a wheat-sorghum-fallow rotation with a tillage operation performed on the contour. Stubble mulch tillage was used to maintain a maximum amount of crop residue on the soil surface to reduce erosion hazard.

The combination of stubble cover and dry soil probably accounts for the small amount of runoff from the wheat field. Runoff potential was greater on the land planted to grain sorghum than on either the fallow or wheat stubble. Total runoff, percent of rainfall measured as runoff on one date and maximum rate of runoff all was greatest on the grain sorghum field.

After July 6, runoff was less from the grain sorghum field than from the fallow field. It is theorized that drying of the soil through evapotranspiration by the growing sorghum crop is responsible for the reduction in relative runoff from the grain sorghum field.

ARS, USDA., Bushland, Tex.

Hays, Orville E., and Attoe, Osborne J. CONTROL OF RUNOFF AND EROSION ON ALMENA SILT LOAM IN WISCONSIN. U. S. Agr. Res. Serv. ARS 41-16, 19 pp. 1957.

Almena silt loam, a poorly drained soil with a silt pan, was studied on a 3% slope on a slope length of 800 feet. Plots 100 feet wide and 300 feet long were selected. Part of the area had terraces built with a 6% gradient.

The treatments were a 4-year rotation of corn, spring grain, and two years of hay - planted on the contour, planted up and down slope, and planted parallel to the terraces - and a 3-year rotation of fall grain (changed to spring grain in 1953) and two years of hay - planted up and down slope and planted on the contour. In 1947 the treatment of the 4-year rotation, contour planted plots, was changed to contour strip cropping with the same rotation.

Runoff - Corn lost more runoff than grain land in seven of the nine years of measurement. Hay allowed about 40% as much runoff as corn. Contour strip cropping reduced the runoff from all crops as compared with up and down slope planting. With corn on alternate strips runoff was reduced by more than 50%. For all four crops, the average annual runoff from planting up and down slope was 1.36 inches. From planting in a strip crop system it was 0.69 inches, and planting parallel to the terrace was 1.58 inches.

Soil Losses - The highest soil loss occurred where corn was planted up and down slope (average annual soil loss of 3.3 tons per acre). The average soil losses for the rotation from up and down slope planting, strip cropping and terrace were 0.8, 0.2, and 0.4 tons per acre, respectively.

Rotation - Losses of both soil and water were quite low from both rotations. Average annual runoff from the CGHH rotation was 1.01 tons per acre and from the GHH rotation 0.12 tons per acre.

Corn Yield - For the 11-year period, corn planted up and down slope yielded 56.1 bushels per acre, contour strip cropped 56.3 and planted parallel to terraces 54.4 bushels per acre. Yields of oats averaged 59.4 bushels per acre from up and down slope planting, 57.5 from contour strip cropping, and 58.2 from planting with the terraces.

ARS, USDA, U. of Wis., Madison, Wis.

Held, R. B., and Timmons, J. F. SOIL EROSION CONTROL IN PROCESS IN WESTERN IOWA. Iowa Agr. and Home Econ. Expt. Sta. Res. B. 460, pp. 296-315, illus. August 1958.

The study reported was built on the findings of an earlier study of the problems of controlling soil erosion losses on a sample of 144 farms in western Iowa. That study indicated that several factors, largely economic in nature, usually accounted for the failure of farm operators to use the practices necessary to reduce soil losses. The present study examined each farm situation further to decide whether changes in these factors were responsible for corresponding changes in loss of soil. It was found that progress among farms in reducing losses from soil erosion had been slow. From 1949 through 1952, the annual rate of soil loss averaged a decline of only 1.5 tons per acre on the 144 farms. But on 69 farms, erosion losses were increased by about 7 tons per acre per year, while on 70 farms losses were decreased by about 9 tons per acre per year. The average rate of loss on all farms was still nearly 20 tons per acre annually. Farmers were using the erosion-control practices of contouring, commercial fertilizers, terracing, and grassed waterways to a greater extent than formerly. Habit, custom, and lack of knowledge concerning the benefits to be obtained from use of erosion practices continue to be responsible for heavy soil losses. Farm owners and operators had little incentive to sacrifice immediate incomes or to make erosion-control investments if they had insufficient assurance of receiving compensating benefits. Major causes for failure to reduce soil losses during the period studied apparently were uncertainty of tenure, lack of adequate finances, greater reluctance to assume risk, and lack of confidence in recommended practices. The problem is a continuing one; it varies from farm to farm.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Cropping Systems

Larson, W. E., Brooks, S. N., Aasheim, T. S., and Post, A. H. IRRIGATED CROP ROTATIONS AT THE HUNTLEY BRANCH STATION. Mont. Agr. Expt. Sta., in coop with SWC Res. Div., ARS, U. S. Dept. of Agr. B. 535, pp. 78. 1958.

Irrigated crop rotation experiments were started at the Huntley Branch of the Montana Agricultural Experiment Station in 1912 soon after the Huntley Reclamation Project was opened for settlement in 1907. Some of these early rotation treatments have remained unchanged since that time and now represent some of the oldest irrigated studies of this kind in North America.

Earlier summaries of the rotation experiments were made in 1929 and 1937 and the last analysis was published in 1943. In recent years most of the rotation treatments have been discontinued and at present only 5 are in existence. This bulletin brings together into one publication the most important findings and is the final complete report of this study. A brief discussion and illustrative summary tables and graphs are included in the text of the report. A rather complete listing of all the data is included in the appendix.

The general objectives of these studies over the years were as follows:

1. To determine what crops and what sequence of crops were the most suitable for irrigated crop production in this area.
2. To measure the effect of barnyard and green manure on crops yields.
3. To determine the importance of alfalfa in a crop rotation.
4. To compare the yields of crops grown continuously with those grown in 2-, 3-, 4-, and 6-year rotations.
5. To determine the effects of fertilizers on crop production in various rotations.

ARS, USDA, Mont. Agr. Expt. Sta., Bozeman, Mont.

Schmid, A. R., Caldwell, A. C., and Briggs, R. A. EFFECT OF VARIOUS MEADOW CROPS, SOYBEANS, AND GRAIN ON THE CROPS WHICH FOLLOW. Agron. J. 51: 160-162. 1959.

Four crop-sequence experiments comparing the effects of various types of one- and two-year meadows, grain, and soybeans on yields of crops that follow are reported. Corn was used as the indicator crop in three experiments and wheat in the fourth. An attempt was made to measure the nitrogen factor by application of fertilizer nitrogen. The most important results were as follows:

1. Nitrogen was the most important single factor influencing yield of corn and wheat following meadows, grain, and soybeans. However, at one location the higher yields following grass with and without added nitrogen as compared to those following grain would indicate that some additional soil factor or factors were affected.

2. The big contribution of nitrogen by one- and two-year legume meadows was evident in all experiments. Crops which followed showed no response from fertilizer nitrogen the first year after the legume.

3. The first year of corn following soybeans with residue returned was better by about 15 bushels per acre than corn following oats, but this was not true in the second year of corn.

4. Birdsfoot trefoil was as effective as alfalfa in increasing yields of corn which followed.

5. Grass alone had a deleterious effect on wheat yields with and without nitrogen added compared to wheat yields following grain or alfalfa.

U. Minn., St. Paul, Minn.

Ayers, H. D. THE EFFECT OF CROP COVER ON THE INFILTRATION CHARACTERISTICS OF GUELPH LOAM SOIL. Canada J. Soil Sci. 37: 128-133. 1957.

Application of simulated rainfall to a Guelph loam soil indicated that a dense cover crop of grasses and legumes served to maintain the infiltration capacity above 1.6 inches per hour during the first 60 minutes of wet runs. When the cover was removed and the soil surface prepared to simulate finely prepared seedbed the infiltration capacity dropped to 0.7 inches per hour or less after 60 minutes. The mass infiltration of water during the initial runs on plots appeared to be inhibited by air entrapment in the soil profile.

Ontario Agr. Col., Guelph, Ont., Canada.

Murphy, H. F. GREEN MANURE AND COTTON IN A DOUBLE-CROPPING SYSTEM ON A FINE-TEXTURED SOIL. Okla. A&M Col. B. No. B-472. 1956.

The experiments reported in this bulletin were designed to determine the value of growing a green manure crop in a double cropping system on a fine-textured soil under Oklahoma limited rainfall conditions.

The experiments were conducted during a 21-year period (1934-54). Rainfall during that period averaged 29.79 inches with a range from 16.91 to 38.68 inches. The general effect of double cropping with green manure and cotton each year was a reduction in yield of seed cotton. Also, nitrogen content of the soil decreased during the 21-year period.

Cotton yields also decreased when a winter green manure crop was grown in a rotation system of cotton, an annual legume, and wheat. Nitrogen content of the soil decreased in the rotation system, but the loss was less than in the continuous cotton system. Nitrogen loss was less where the green manure was used in the rotation than where no green manure was used.

Okla. A&M Col., Stillwater, Okla.

Stivers, Russell K. INFLUENCE OF INTERPLANTING OF CORN AND LADINO CLOVER ON THE YIELDS OF CORN. Agron. J. 48: 97-98. 1956.

Corn was grown in association with an established stand of ladino clover in Virginia by turning under strips of the ladino sod and preparing the areas for corn. Corn was grown adjacent to ladino clover, adjacent to a cultivated area without corn, or in conventional manner. Ladino clover growing adjacent to corn reduced corn yields. In addition, there was a trend toward a reduction in ear weights. Nitrogen leaf deficiency symptoms and response to fertilization of corn indicated that ladino clover was competing with corn for available soil nitrogen. Where corn rows were 80 inches apart with a 40-inch ladino clover strip between them, average corn yields were increased approximately 13 bushels per acre by the application of 100 pounds per acre of nitrogen.

Purdue U., Lafayette, Ind.

Thompson, R. K., and Day, A. D. SPRING OATS FOR WINTER FORAGE IN THE SOUTHWEST. Agron. J. 51: 9-12. 1959.

Five experiments were conducted over a 4-year period (1955-58) at Mesa, Ariz., to study the forage production of irrigated spring oats and spring barley grown during the winter months. The following four oat varieties were used in the experiments; Markton, California Red, Palestine, and Colorado White. Three barley varieties were used for comparison: Harlan, Vaughn, and Arivat.

Spring oats can be successfully grown during the winter months for pasture, green chopped feed, and hay production in the Southwest.

Winter pasture forage yields equivalent to 18 tons per acre were obtained from spring oats. Markton was the most desirable variety for sustained winter pasture production. Oats should be grazed at the onset of the jointing stage throughout the winter pasture season for the most uniform and sustained vegetative growth. Spring oats produced more winter pasture forage than spring barley.

Spring oats produced green chopped feed yields up to 30 tons per acre. Markton offered the greatest promise for green chopping of all varieties tested. In general, as the harvest date was delayed, the protein, carotene, and vitamin A content of the green chopped forage decreased.

High hay yields, up to eight tons per acre, were obtained from spring oats grown as winter annuals. Of the varieties tested, Markton was the best suited for hay production. The carotene and vitamin A content of oat hay decreased rapidly when the crop was exposed to full sunlight during drying.

U. Ariz. Tucson, Ariz.

Gray, F., and Harper, H. J. A FEED CROP ROTATION FOR CENTRAL AND EASTERN OKLAHOMA. Okla. A&M Expt. Sta. B. No. B-465. January 1956.

A suggested feed crop rotation for central and eastern Oklahoma, based on the results reported in this bulletin, is as follows:

First Year: Spring oats in 14-inch rows, overseeded with biennial sweet clover.

Second Year: Second-year sweet clover, followed by rye sown about September 15 for winter pasture.

Third Year: Sudan grass for pasture or hay.

Fourth Year: Sorghum for silage.

This rotation will produce about 3 times as much protein as the same acreage in good prairie hay. And it will do a satisfactory job of controlling erosion on sloping land.

Agr. Expt. Sta., Stillwater, Okla.

Residue Management

Army, T. J., and Hide, J. C. EFFECTS OF GREEN MANURE CROPS ON DRYLAND WHEAT PRODUCTION IN THE GREAT PLAINS AREA OF MONTANA. *Agron. J.* 51: 196-198. 1959.

Long-term experiments to determine the effects of green manures on dryland wheat yields were conducted at Branch Agricultural Experiment Stations at Havre, Huntley, and Moccasin, Montana.

Green manure crops of sweetclover, field peas, and winter rye grown during part of the usual fallow period had no beneficial effects on dryland wheat yields. Test weight and protein content apparently were not affected by the use of green manures. Chemical analyses at the conclusion of the experiments showed no evidence that the green manure crops materially affected the nitrogen or carbon content of the soil.

The crop and weather data from the three locations examined suggest that with present cultural techniques green manures should not be used for the production of spring or winter wheat on soil of the Brown and Chestnut Great Soil Groups.

Mont. Agr. Expt. Sta., Bozeman, Mont.

Stickler, F. C., and Johnson, I. J. THE INFLUENCE OF CLIPPING ON DRY MATTER AND NITROGEN PRODUCTION OF LEGUME GREEN MANURES. *Agron. J.* 51: 137-138. 1959.

An experiment was conducted in 1957 at Ames, Iowa, to determine the influence of stubble clipping in July and/or August on seasonal and on fall dry matter and nitrogen yields of legume tops and roots. Madrid sweetclover excelled as a green manure without clipping but yields were drastically reduced by clipping. Dry matter and nitrogen yields obtained in summer clippings failed to compensate for this yield loss.

Clipping increased dry matter and nitrogen yields of alfalfa, red clover, and Ladino white clover. The effects of clipping accrued from removal of weed competition with resulting changes in individual plant development.

Top and root yields were highly correlated within each species.

Kans. State Col., Manhattan, Kans.

Tillage and Cultural Practices

Byers, G. L., and Webber, L. R. TILLAGE PRACTICES IN RELATION TO CROP YIELDS, POWER REQUIREMENTS AND SOIL PROPERTIES. *Canada J. Soil Sci.* 37: 71-78. 1957.

Tillage experiments were conducted on Burford loam and Lockport clay loam. Different implements and combinations of implements were used to accomplish nine methods of tillage. The moldboard plow was used as a standard treatment and compared with other treatments using a plow equipped with sub-bases, a disc plow, a one-way disc, a field cultivator, and rotary hoe. Crop yields, power requirements, and the effect on soil physical properties were studied.

On Burford loam, with a 5-year rotation of corn, oats, and hay for three years, the yield of oats was significantly better when the fall tillage included moldboard plowing. No tillage treatment resulted in significant differences in the yields of corn as silage, and of hay. On Lockport clay loam, the crop yields from a rotation of corn, oats, hay, fall wheat, and red clover, were not significantly affected by tillage treatment.

Tillage treatments did not produce significant differences in soil aggregation, bulk density or aeration porosity in any year of the experiment. Significant differences were from year to year when the mean values of all treatments were compared.

The power required to accomplish the tillage treatments were measured.

Ontario Agr. Col., Guelph, Ont., Canada.

Bolton, E. F., and Aylesworth, J. W. A COMPARISON OF SOME TILLAGE METHODS FOR CORN ON BROOKSTON CLAY SOIL. Canada J. Soil Sci. 37: 113-119. 1957.

Methods of mulch-planting were compared with moldboard-plowing methods for corn production at Woodslee during 1953, 1954 and 1955. The tillage treatments were established in second-year alfalfa sod on Brookston clay soil. On the basis of corn yield the conventional plowing treatments were greatly superior to any mulch-plant method tested during the three years. Soil moisture studies indicated that the effect of the intercrop on the soil moisture supply was the major factor influencing crop yield, but moisture alone did not account entirely for the differences obtained in crop yield. The plow-plant method produced as good corn yields as spring plowing in 1953 but somewhat less in 1954 and 1955. The results would suggest that an adaptation of the plow-plant method may have possible application as a tillage method for corn on the finer textured soils of southwestern Ontario.

Canada Dept. Agr., Woodslee, Ont., Canada.

USDA, Soil and Water Conservation Research Division, ARS. SOIL-CONSERVING TILLAGE SYSTEMS FOR CORN. U. S. Dept. Agr. Farm. B. 2188, 16 pp., illus. August 1958.

The following corn tillage systems offer farmers an opportunity to reduce the cost of growing corn and to do a better job of conserving soil and water. Tests show that, in many instances, yields for all systems have been about equal.

Each system is suited to specific soil conditions. No method is a "cure-all" for all conditions. Many farmers, however, should be able to pick a system to help them cut costs and reduce erosion.

Mulch tillage permits corn to be grown where the residue of the previous crop has been left on the soil surface. It conserves soil and water.

Double-cut plowing, a variation of the mulch tillage system, turns over thin strips of sod and tills the soil beneath the sod to a depth of 6 inches. It is the best mulch tillage system known for growing corn following meadow or pasture.

Manure mulching is simply the practice of spreading manure on the seedbed either before or after the corn has come up.

Plow-plant eliminates some of the preplanting operations and helps control erosion because it avoids pulverizing and packing the seedbed. There are several variations of the plow-plant system, all of which allow late plowing and immediate, follow-up planting of the corn.

Ridge-row tillage is a system whereby corn is planted on ridges of soil turned over on undisturbed soil. Ridge-row tillage was designed primarily for use on slow-draining soils and for holding back runoff on slopes.

Listing is the reverse of ridge-row tillage--that is, corn is planted in the bottom of furrows. It is one of the most rapid methods of getting a corn crop into the ground.

Corn-sod intercropping covers a number of practices--all designed to permit the seeding of grasses and legumes between corn rows. Spaces between corn rows are usually wider than the common 40- or 42-inch widths.

Inform. Division, ARS, USDA, Washington 25, D. C.

Schmidt, J. L., and Lovely, W. G. REPORT ON EFFECTS OF CORN TOPPING. U. S. Agr. Res. Serv. ARS-42-35, 10 pp. 1959.

In this experiment the effects of corn topping on moisture content, yield, stalk breakage, shelling percentage, and the test weight of the shelled corn were studied.

The topping machine was set to cut the stalk just above the tip of the highest ear in the row. This setting cut about 3 feet off the top of the plant which is equivalent to taking the tassel and the first 4 or 5 leaves. The corn was topped (treated) at four different stages of growth. They were:

Ten days after pollination;

Roasting ear stage;

Dented stage;

In final maturing stage.

The results of these corn topping experiments did not show any significant effects from topping on the various corn factors studied. Kernel moisture contents, test weights, and stalk breakage percentages of topped corn were about the same as in untopped corn. Although not significant, the cob moisture contents in topped corn averaged a slightly higher, and the shelling percentages and yields averaged slightly lower than in untopped corn.

Stands, lodging, pre-harvesting losses, or harvesting losses were approximately the same for different topping dates and between topped and untopped corn. The losses with the picker, picker-sheller, and the combine were not reduced by topping. Topping did not have any effect on losses for either early or late harvesting.

Results from a study of this type however are highly dependent upon weather conditions existing during the study. For example, the 1958 season with ample moisture and sunshine was an ideal season for an excellent corn crop. Weather conditions of this season may have reduced both the favorable and unfavorable effects expected of corn topping. Only with repeated studies over several years can the true effects of corn topping be established.

Inform. Div., ARS, USDA, Washington 25, D. C.

Brown, Paul L., and Shrader, W. D. GRAIN YIELDS, EVAPOTRANSPIRATION, AND WATER USE EFFICIENCY OF GRAIN SORGHUM UNDER DIFFERENT CULTURAL PRACTICES. Agron. J. 51: 339-343. 1959.

The influence of plant population, row spacing, and soil moisture or grain sorghum yields, evapotranspiration, and water use efficiency was studied at Hays, Kansas, in 1954 and 1955 under drought conditions. Plant populations varied from 15,000 to 120,000 plants per acre in 10-, 20-, and 40-inch rows. Soil moisture levels were established prior to planting by applying water to wet the soil to field capacity to depths of 3, 5, and 7 feet.

For the two-year period, grain yields averaged 11.4, 23.6, and 40.6 bushels per acre on the 3-, 5-, and 7-foot moisture plots, respectively. Evapotranspiration for these same plots averaged 11.6, 14.8, and 17.0 inches of water, and stored soil moisture supplied an average of 49, 60, and 65% of this evapotranspiration.

Optimum plant populations and row spacings as reflected by grain yields for the three initial soil moisture conditions follow:

	Initial soil moisture depths					
	3 feet		5 feet		7 feet	
	1954	1955	1954	1955	1954	1955
Optimum plants per acre	15-30,000	15,000	60,000	30,000	60-90,000	30-90,000
Optimum row spacing (in.)	20	40	20	40	10-20	40

It is quite possible that lower plant populations and wider row spacings might have shown greater yields in 1955, had they been included in the experiment.

Under extreme drought conditions in 1955, wide row spacings and low plant populations reduced forage production and increased water use efficiencies. There was an inverse relationship between forage production and grain water use efficiency.

SWC, ARS, USDA, Bozeman, Mont.

Pauli, A. W., and Laude, H. H. PROTEIN AND CARBOHYDRATE RELATIONSHIPS IN WINTER WHEAT AS INFLUENCED BY MECHANICAL INJURY. Agron. J. 51: 55-57. 1959.

Pawnee winter wheat plants were injured by lodging the stems or removing leaf blades at one of several stages before maturity. Effects of mechanical injuries were studied relative to accumulation of nitrogen, translocation of nitrogen and carbohydrates to the grain, protein percentage in the grain, pounds of protein and crude starch produced per acre, and acre yields of grain.

Each of the mechanical injuries caused smaller accumulations of nitrogen in the plant, decreased translocation to the grain, and decreased production per acre of protein and crude starch.

Greater decreases in yields caused by lodging two weeks after heading may have been caused by restrictions in subsequent translocation imposed by crushed tissue and by smaller quantities of water taken into the plants. Lower water content of leaves of lodged plants may have contributed to decreased rates of photosynthesis, decreased carbohydrate production, reductions in amino acid synthesis and decreased protein production. Large decreases in acre yields when leaf blades were removed at or just prior to heading were apparently associated with loss of nitrogen accumulated in the leaves and with decreased photosynthetic tissue.

Production of carbohydrates was decreased proportionately more than that of protein when plants were lodged, causing higher percentages of protein in the grain. Removal of leaf blades caused proportionately greater decreases in amount of protein in the grain compared with carbohydrates, causing lower protein percentages.

Kans. Agr. Expt. Sta., Manhattan, Kans.

Kennard, W. C., and Morris, M. P. INFLUENCE OF CULTURAL PRACTICES ON TUBER YIELDS AND SAPOGENIN CONTENT OF Discorea floribunda. Agron. J. 48: 485-487. 1956.

Significantly higher yields of tropical yams and significantly higher sapogenin content were found in tuber growth with adequate support of vines. Chicken wire trellis gave best support to the vines. Both yield and sapogenin content were higher in the second year growth of plants than in the first year.

Fed. Expt. Sta., Mayaguez, Puerto Rico.

McGinnies, William J. THE RELATIONSHIP OF FURROW DEPTH TO MOISTURE CONTENT OF SOIL AND TO SEEDLING ESTABLISHMENT ON A RANGE SOIL. Agron. J. 51: 13-14. 1959.

Seeding arid rangeland is not always successful because inadequate soil moisture frequently limits germination and retards early growth.

The use of furrows 2 to 4 inches deep significantly increased soil moisture available for seed germination on a range soil by reducing the rate of moisture loss. Seedling establishment was improved by using a 4-inch deep furrow.

The results of this study indicate that furrows, if deep enough, can have a pronounced effect on increasing soil moisture content and improving the seedling stand. There are other aspects of deep furrow planting that must also be considered. In unstable soils, the soil may slough into the furrow and cover the seed too deeply. Torrential rains can wash soil into the furrows and bury the seedlings. Under wet conditions, the furrows can collect and hold water to the point of drowning seedlings. The furrows will undoubtedly be more effective in increasing soil moisture content under certain soil and climatic conditions. In spite of these hazards, the improvement in soil moisture relationship is so good that the method deserves careful examination for range seedings whenever soil moisture is a critical problem in establishing the grass stand.

Range Conserv. CRD, ARS, USDA, Fort Collins, Colo.

Lorenz, Russell J., and Rogler, George A. EFFECT OF ROW SPACING AND NITROGEN FERTILIZER ON PRODUCTION OF IRRIGATED RUSSIAN WILDRYE (ELYMUS JUNCEUS FISCH.) I. FORAGE YIELDS. Agron. J. 51: 286-288. 1959.

A study with irrigated Russian wildrye was conducted using 6-, 18-, and 36-inch row spacings, fertilized with annual applications of 0, 100, 200, and 400 pounds of nitrogen per acre.

Although differences in forage yields due to row spacings were not significant in many cases, the trend was toward slightly higher yields at the wider spacings, particularly after the first harvest year when the plants at the 36-inch spacing had enlarged to compensate for lower plant populations.

Nitrogen fertilizer had a much greater effect on forage yield than did row spacing. Each increment of nitrogen produced a significant increase in forage yield each year after 1954. There was no significant differences between the 200- and the 400-pound rate of nitrogen in 1954.

Response to nitrogen fertilization for each row spacing differed from year to year. The largest average increase in yield as a result of the application of nitrogen occurred at the 18-inch spacing in 1954, and 1955, at the 6-inch spacing in 1956, and at the 36-inch spacing in 1957.

A large decrease in yield occurred on all plots from 1954 to 1955, followed by a smaller decrease each year for the next 2 years with very little change from 1956 to 1957.

The greatest year to year decrease in yield occurred in the unfertilized plots, particularly at the 6-inch spacing.

CRD, ARS, USDA, Beltsville, Md.

Equipment

Collison, Frederick E., and Novak, Gene H. IMPROVEMENTS IN USING POWER FOR SOIL SAMPLING. J. Soil & Water Conserv. 13: 78-80. 1958.

Wet or dry heavy clay soils are a scourge to soil surveyors. These gumbos or adobes, as they are sometimes referred to by farmers, are not only tough to sample but to farm. Auger extractions and cleaning are difficult when the soils are wet and sticky. Under dry conditions, boring is laborious.

In the basin of California's San Joaquin Valley are large acreages of heavy clays. These soils are plagued by high water tables. Excess salts further complicate farming operations. Drainage can help in reclaiming and improving these soils in much of the Valley. For placement of workable surface and tile drains, detailed subsurface soil investigations are required. Power augers have been employed.

This article describes how a power auger can be built for \$1,450.00 and placed on a Willis 4-wheel drive pickup. The new auger can bore up to 20 feet-10 feet without the necessity of making and breaking extensions. All three basic types of augers, conveyor, orchard and tube are successfully used. A number of design and operation features are incorporated that insure the safe use of this machine, protecting both the operator and equipment and the authors' claim both time and expense can be saved by using this machine.

Illustrations

SCS, Fresno, Calif.

Rowe, R. J., and Lovely, W. G. A LISTER PLANTER ATTACHMENT FOR SIDE-BAND PLACEMENT OF STARTER FERTILIZER. U. S. Agr. Res. Serv. ARS-42-26. May 1959.

Details for the modification of a commercial 2-row lister planter to place starter fertilizer 2 inches to the side of and 2 inches below the seed are given. Field tests have shown the machine will so place the fertilizer, but some increase in draft was noted.

Inform. Div., ARS, USDA, Washington 25, D. C.

West, W. S. MECHANIZATION OF THE POTATO HARVEST IN THE UNITED STATES OF AMERICA. J. Agr. Engin. Res. 3: 172-178, 1958.

This is a report of a visit to the United States: (1) to study the latest U. S. developments in potato harvesting techniques and equipment; and (2) to discuss with the appropriate workers the research being done on the various aspects of the harvesting problem. The areas visited were New York State (Suffolk County, Long Island and Ithaca), Maine (Aroostook County and Orono), Michigan and Minnesota (St. Paul and the Red River Valley).

A comparison is made of the differences in growing potatoes in the different sections studied in the United States and different sections in the United Kingdom.

Equipment used to harvest potatoes in the different sections of the United States under study was discussed.

The principal value of the study was to see how well the United States Potato Growers had solved their harvesting problems, and if the improved methods could be used in the United Kingdom.

Natl. Inst. Agr. Engin., Silsoe, Eng.

Irons, Frank. HAND SPRAYERS AND DUSTERS. U. S. Dept. Agr., Home and Garden B. 63. December 1959.

Hand-operated sprayers and dusters are effective weapons for use with pesticides to control insects, weeds, and plant diseases in the home, in the yard and garden, and on the farm.

In the home, this equipment is important in protecting the family from insects that carry diseases, contaminate and destroy food, damage and destroy clothes, and cause personal discomfort.

In the yard and garden, sprayers and dusters are essential in protecting flowers, ornamental shrubbery, trees, vegetables, and fruit crops from insects and diseases. When used with weed-killing chemicals, this equipment simplifies the chore of eliminating unsightly weeds from the lawn.

On the farm, hand-operated, mobile sprayers and dusters are useful for many spraying or dusting jobs where the use of larger and more expensive equipment may not be justified. They can also be used for spot treatment of pastures and field and forage crops to supplement larger power-operated units.

Other farm uses include: Controlling pests on poultry, cattle, and hogs; cleaning and disinfecting poultry and livestock buildings; applying whitewash and shingle stain; fighting small fires; applying rust inhibitors, detergents and other grease solvents; and eradicating weeds and brush.

The different types of sprayers are illustrated and described along with recommendations for their proper use.

Inform. Div., ARS, USDA, Washington, D. C.

Reed, I. F. DISK PLOWS. U. S. Dept. Agr. Farm. B. 2121, 12 pp., illus. November 1958.

Disk plows are of two types--the standard and the vertical. Both have concave disk blades for working the soil. These disks may be 18 to 32 inches or more in diameter.

The standard disk plow usually has 1 to 6 disks. Each disk is independently mounted at an angle from the perpendicular. This angle can be adjusted to adapt the plow to different soil conditions.

The vertical plow has a series of disks mounted on a common axle, or gangbolt. They are in a vertical position and spaced a fixed distance apart. The disks and the axle rotate as a unit at an angle of 35° to 60° with the line of travel. This plow is known also as the one-way disk plow, disk tiller, harrow plow, wheatland plow, and cylinder plow.

This Farmers' Bulletin compares disk plows with moldboard plows and then explains how to adjust and operate the standard disk plow and the vertical disk plow.

Inform. Div., ARS, USDA, Washington 25, D. C.

Richardson, R. D. THE PERFORMANCE OF DOWN-THE-ROW THINNERS OPERATING IN SUGAR BEETS. J. of Agr. Engin. 3: 299-323. 1958.

The performance of down-the-row thinners in crops of sugar beet is considered in terms of the reduction in the number of seedlings, and the effect on the proportion of singles, and on the seedling distribution. The results to be expected from ideal treatments are considered and data from field experiments are analysed.

The reduction achieved by thinning treatments during experiments carried out in 1953-4 varied widely. It was found that the use of blades less than 1 in. in length improved the singleness obtained. The effect of treatments on plant distribution was in broad agreement with theory although the interaction of individual drill and thinner units requires investigation. Some comments are made on design features of drills and thinning machines.

Natl. Inst. Agr. Engin., Silsoe, Eng.

Saline and Alkali Soils

Umback, C. R., Fine, L. O., and Wiersma, F. THE EFFECTS OF IRRIGATING SOILS OF THE PROPOSED SHADEHILL PROJECT WITH WATERS HIGH IN SODIUM AND BICARBONATE IONS. S. D. Acad. Sci. Proc. 38: 88-95. 1959.

The effect of the application of low-quality water from Shadehill Reservoir upon the accumulation of salts and alkali in soils typical of the proposed Shadehill Irrigation Unit was studied. It appears that exchangeable sodium percentages are in equilibrium with the water being applied (at least in the upper portions of the soil profile). Under the conditions of annual rainfall found at this location (about 15 inches per year), the "residual Na_2CO_3 " content of the water has not, under field conditions, induced further increases in exchangeable Na beyond those levels otherwise anticipated.

The effects of leaching were not studied in the field because this did not become necessary. Gypsum was applied with the irrigation water in amounts chemically equivalent to the "residual Na_2CO_3 " and appeared to induce equilibrium between ESP and sodium in the water at levels somewhat lower than were otherwise found. Infiltration rates were equal or possibly slightly superior under the gypsum treatment.

Alfalfa production under irrigation was found to be comparable to that in other areas of the state under irrigation. This was equal to about a five-fold increase over dry-land production on these same soils.

SWC, ARS, USDA, S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Longenecker, D. E., and Lyerly, P. J. CHEMICAL CHARACTERISTICS OF SOILS OF WEST TEXAS AS AFFECTED BY IRRIGATION WATER QUALITY. Soil Sci. 87: 207-216. April 1959.

Filed and laboratory studies were conducted to determine the effects of poor quality irrigation waters on soils of the Texas Trans-Pecos region. Waters used for irrigation in the areas studied contain large amounts of salt, or are otherwise unsatisfactory due to poor ion balance.

Representative soil sampling sites were chosen throughout four separate pump-irrigated areas, and samples of virgin soil, cultivated soil, and irrigation water taken at each site. Comparisons were made from soil and water analyses. Soils of the Wild Horse, Dell City, and Pecos areas are freely permeable and well drained, and with good management should continue to remain productive despite the high salt content of irrigation waters. Poor permeability and high Na content in the subsoils limit production on the finer-textured soils of the Lobo Flats area.

The highly significant correlations between the S.A.R. of saturation extracts from these soils and the exchangeable Na percentages, appear to be good enough to be useful in predicting the exchangeable Na status of these soils by analysis of the saturation extract. A significant correlation also was found between salt content of irrigation waters and salt concentration in the irrigated soils.

Considerable quantities of gypsum have been deposited in the Pecos soils from continued application of highly saline waters over a period of 15-20 years.

Tex. Agr. Expt. Sta., Yaleta, Tex.

Cooper, William C., Peynalo, Ascension, and Olson, Edward O. RESPONSE OF GRAPEFRUIT ON TWO ROOTSTOCKS TO CALCIUM ADDITIONS TO HIGH-SODIUM, BORON-CONTAMINATED, AND SALINE IRRIGATION WATER. *Soil Sci.* 86: 180-189. 1958.

Young Webb Red Blush grapefruit trees on sour orange and Cleopatra mandarin rootstocks were irrigated for a 4-year period with a saline high-Na water contaminated with B to which were added known levels of calcium nitrate, calcium sulfate, or ammonium nitrate. Observations were made on growth and B and salt toxicity, and chemical analyses were made of the leaves and roots for contents of Na, K, Ca, Mg, chloride, sulfate, N, and B.

There was an appreciable influence of treatment and rootstock on growth and on salt and B toxicity. The trees on sour orange rootstock were less tolerant to the saline well water than were trees on Cleopatra mandarin. There were no definite symptoms of either chloride, Na, or sulfate toxicity, although there was an appreciable accumulation of these ions. B-toxicity symptoms were quite apparent and were lessened by addition of calcium nitrate to the well water through a reduction in B Accumulation. There was, however, no evidence that B toxicity was a primary factor in the decline of the trees in sour orange rootstock. It was not possible to distinguish clearly the mechanism underlying all of the toxic effects of the saline well water.

CRD, ARS, USDA, Weslaco, Tex.

Richards, L. A. AVAILABILITY OF WATER TO CROPS ON SALINE SOIL. Agr. Inform. B. 210. 1959.

The weight of growing crops is composed mostly of water. Flow of water into the roots and out through the leaves is normal for most crops in carrying on growth processes. If water in the plant becomes deficient, either by excessive evaporation or by limited availability in the soil, the rate at which the plant can grow is decreased.

Many factors control growth, such as nutritional elements in the soil and physical conditions in the whole plant environment, but water status within the plant is always a major factor and is often limiting. Soil salinity directly affects the availability of water to plants.

The availability of water to plants is influenced by two force actions.

Matric suction is the suction required to get water back out of the soil. It depends on the amount of water in the soil. The soil moisture tensiometer is an instrument that can be used to measure matric suction up to about 85 centibars.

Solute suction depends on the salt concentration in the soil solution. Solute suction plus matric suction give the total suction that acts against the entry of water into plant roots. When other growth factors are favorable, the rate of growth of crop plants decreases as the total suction of water increases.

Plant roots actually contact only a small fraction of the soil particles. Supply of water to the plant, therefore, depends not only on the condition of water in the soil layer next to the root but also on the movement of water through the soil to replace the water that has passed into the root.

Water flow in moist soil takes place in the water films surrounding the soil particles.

In general, if soil contains much salt, solute suction will be high. To obtain good plant growth, saline soil must be kept at a high moisture content because this reduces both matric suction and solute suction. In effect, the presence of soluble salt limits the amount of water that can be extracted from the soil root zone by the crop before irrigation is again needed to maintain good growth.

The best way to detect soil salinity is to test the soil. Salinity tests are inexpensive.

It is a relatively simple operation to extract a sample of the solution from a saturated soil paste and to measure the electrical conductivity. Portable sets for measuring salinity by this method have been designed by the U. S. Department of Agriculture and are available commercially.

Inform. Div., ARS, USDA, Washington 25, D. C.

Pearson, George A. FACTORS INFLUENCING SALINITY OF SUBMERGED SOILS AND GROWTH OF CALORO RICE. *Soil Sci.* 87: 198-206. April 1959.

A greenhouse experiment designed to study the effect of initial soil salinity, salt content of the irrigation water and rate of drainage on the salinity of two submerged soils (Chino c and Diablo cl) and the growth of Caloro rice indicates that:

- (a) Conductivity of soil solution is related directly to conductivity irrigation water and inversely to rate of drainage.
- (b) Together, conductivity of irrigation water and rate of drainage accounts for 90 percent of the variance in conductivity of the soil solution.
- (c) In soils which have some internal drainage, even though limited, soluble salts initially present are moved downward by the applied irrigation water and have relatively little influence on final conductivity of soil solution.
- (d) In all instances, conductivity of soil solution exceeded conductivity of applied water due to loss of water evapotranspiration.
- (e) Evapotranspiration is directly proportional to total amount of dry material produced.
- (f) Seedlings are quite sensitive to salinity during early development but are progressively less sensitive at 3 and 6 weeks of age.
- (g) Growth is adversely affected by increasing levels of salinity, the effects being less pronounced on vegetative growth than on reproduction.
- (h) A 50 per cent decrease in yield of grain is associated with a soil solution conductivity of 8 mmho. in the active root zone during the growing season.

U. S. Salinity Lab., Riverside, Calif.

Amemiya, M., and Robinson, C. W. THE USE OF UNDISTURBED SOIL CORES TO INVESTIGATE THE RECLAMATION OF SALINE AND ALKALI SOILS. *Soil Sci. Soc. Amer. Proc.* 22: 76-78. 1958.

Field leaching investigations relative to the reclamation of saline and alkali soils generally require considerable land area, as well as time and personnel, for establishing and maintaining such studies. Concurrent with a field leaching experiment a laboratory leaching study was made to determine the relationship between results obtained from undisturbed cores in the laboratory and those obtained from field plots. Changes in infiltration rate, soluble salts, and exchangeable-sodium-percentage due to leaching, with and without gypsum, were compared.

In view of the similarity of results obtained from undisturbed cores in the laboratory and field plots, it appears that soil cores, properly encased, can be used to predict with reasonable accuracy the reclaimability of saline and alkali soils. Although laboratory studies will not replace field investigations, cores could be used in making preliminary studies during period outside of the field season. The information thus obtained could then be used in the final selection of treatments to be considered in the field.

Colo. Agr. Expt. Sta., Fort Collins, Colo.

CROPS

General

Stokes, I. E., Coleman, O. H., and Dean, Jack L. CULTURE OF SORGO FOR SIRUP PRODUCTION. U. S. Dept. Agr. Farm. B. 2100, 32 pp. illus. 1957.

The name "sorgo" is commonly used to identify varieties of sorghum that have an abundance of sweet juice. Sorgo is grown for sirup or forage. Cultural methods are similar whether sorgo is used for sirup or forage, but handling methods differ.

Some sorgo is grown for sirup in 35 States. Sorgo is adapted to soil and climatic conditions as diverse as those found in Minnesota and Alabama. Sorgo is grown most extensively for sirup in the Southeastern States. Six States, Mississippi, Alabama, Arkansas, Tennessee, North Carolina, and Georgia, sometimes called the "sorgo sirup belt," produce about 50 percent of the total amount of sorgo sirup.

The desirable characteristics of sorgo varieties for sirup production are: (1) Ability to produce a high yield of medium to large stalks per acre; (2) strong, erect habit of growth, not readily lodging during storms; (3) a high percentage of extractable juice; (4) juice having a high total soluble solids (Brix) content, mostly sugar; (5) resistance to disease; (6) ability to produce a high-quality sirup; and (7) comparatively short growth period. Varieties differ greatly in these qualities, and in their adaptation to soil and climatic conditions. The grower should carefully consider all these qualities in his choice of a variety.

This Farmers' Bulletin describes: (1) The leading varieties in the United States; (2) The cultural practices recommended to grow the crop; (3) Control of disease and insects; and (4) The manufacture of Sorgo Sirup.

Inform. Div., ARS, USDA, Washington 25, D. C.

Crops Research Division, ARS. GROWING SAFFLOWER--AN OILSEED CROP. U. S. Dept. Agr. Farm. B. 2133, 16 pp. 1959.

Safflower is an oilseed crop adapted to the wheat and barley areas of the western United States that have dry atmosphere in the latter part of the growing season.

The crop has been known for centuries in India, the Middle East, and North Africa, where it is the source of a dye and an edible oil. Safflower was introduced experimentally as an oil crop in the United States in 1925. American farmers began growing safflower about the end of World War II.

About 175,000 acres of safflower were planted in the United States in 1958.

In some varieties, the weed contains about 35 percent of oil. Such varieties are available for commercial production. Plant breeders are developing new varieties with increased oil content.

This farmers' bulletin gives a thorough discussion of safflower growing by showing: uses of the crop; adaptation; economic factors; varieties; seed treatments; planting date; cultural practices; irrigation; subirrigation; harvesting and insects and disease.

Inform. Div., ARS, USDA, Washington 25, D. C.

De, P. K., and Mandal, L. N. PHYSIOLOGICAL DISEASES OF RICE. Soil Sci. 84: 367-376. 1957.

Rice plants were grown in waterlogged soils maintained under an atmosphere of (a) air and (b) nitrogen, with and without the addition of ferrous sulfate or sulfuretted hydrogen solution. As indicated by yield and external appearance, the plant growth was normal and healthy, and no disease symptom appeared in any treatment. Periodic analysis of drainage water showed: (a) disappearance of dissolved oxygen after 21 days from soil kept under nitrogen; (b) presence of large amounts of soluble ferrous iron in soil kept under nitrogen and treated with ferrous sulfate solution; and (c) absence of sulfuretted hydrogen or any soluble sulfide in soil kept under nitrogen and treated with

sulfuretted hydrogen solution. The results further showed that drainage water from soils kept under air contained more dissolved oxygen, ferric and ferrous iron, manganese, and total oxidizable matter than that from soils kept under nitrogen.

The evidence obtained does not support the view that the physiological disease of rice observed in normal soils is due either to lack of oxygen or to an accumulation of ferrous iron or production of H_2S in soil.

State Agr. Res. Inst., West Bengal, India.

Field Crops

Penny, L. H., and Dicke, F. F. EUROPEAN CORN BORER DAMAGE IN RESISTANT AND SUSCEPTIBLE DENT CORN HYBRIDS. *Agron. J.* 51: 323-326. 1959.

Eighteen single-cross hybrids among 7 inbred lines of corn were compared at 3 levels of first-brood European corn borer (*Pyrausta nubilalis* Hbn.) infestation. Previous information on the leaf-feeding reaction of the 7 inbred lines used had indicated that 3 were susceptible and 4 were resistant. Leaf-feeding ratings and leaf midrib and sheath lesion counts were recorded as a measure of borer infestation. The differences in yield between insecticide-treated plots and plots in which the natural infestation was supplemented with additional corn borer eggs were used as a measure of borer damage.

The average leaf-feeding ratings of 3 susceptible X susceptible hybrids, 9 susceptible X resistant hybrids, and 6 resistant X resistant hybrids were 7.9, 5.1, and 2.6, respectively, for the 3 years of the test. Leaf-lesion counts in the heaviest borer treatment for the same groups of hybrids were 5.7, 3.5, and 2.2, respectively. The difference in yield between the sprayed plots and the plots which received supplemental egg masses averaged 15.7 bushels per acre for the susceptible X susceptible crosses, 10.1 bushels per acre for the susceptible X resistant crosses, and 6.1 bushels per acre for the resistant X resistant crosses.

In general, the yield losses were closely related to the degree of leaf-feeding resistance of the hybrids. However, factors other than leaf-feeding resistance appeared to have some influence on the damage caused by borer feeding.

CRD, ARS, USDA, Iowa Expt. Sta., Ames, Iowa.

Gingrich, J. R., and Russell, M. B. EFFECT OF SOIL MOISTURE TENSION AND OXYGEN CONCENTRATION ON THE GROWTH OF CORN ROOTS. *Agron. J.* 48: 517-520. 1956.

Increases in soil moisture tension from 1 through 12 atmospheres brought about progressively smaller increases in radicle elongation, fresh weight, dry weight, and degree of seedling hydration. Growth properties were most sensitive in the range between 1 and 3 atmospheres. At low moisture stress, oxygen concentration of the root atmosphere needed to be above 10.5 per cent for maximum growth.

Vt. Agr. Expt. Sta., Burlington, Vt.

Nauheim, C. W., Bailey, W. R., and Merrick, D. E. WHEAT PRODUCTION. U. S. Dept. Agr., Agr. Inform. B. 179. March 1958.

This report describes briefly some of the important changes that have taken place on wheat farms in the United States since 1910. It discusses the historical trends in acreage, yield, production, and utilization of wheat, including exports. A short section is devoted to the world wheat situation, which relates directly to our own export problems.

Future prospects for the utilization and production of wheat in the United States by 1960 and 1975 are appraised and the implications of these prospects are discussed. Some of the major problems that have faced wheat growers, together with government programs dealing with wheat since the 1920's, are discussed briefly.

Inform. Div., ARS, USDA, Washington 25, D. C.

Jones, J. E., Newsom, L. D., and Finley, Etta L. EFFECT OF THE RENIFORM NEMATODE ON YIELD; PLANT CHARACTERS, AND FIBER PROPERTIES OF UPLAND COTTON. *Agron. J.* 51: 353-356. 1959.

Effects of large populations of the reniform nematode on growth and development of cotton were studied in the greenhouse in absence of Fusarium wilt and in the field from 1953 through 1956 in combination with and in absence of wilt. Studies made in the greenhouse with essentially a pure culture of the reniform nematode showed that it reproduces abundantly on cotton and is capable of causing serious injury to the plants.

Under field conditions, the reniform nematode caused an appreciable reduction in yield for all varieties tested. It also caused a delay in maturity, a reduction in size of boll, and in some years a reduction in lint percent. It has little or no effect on size of seed, fiber length, fiber strength, and fiber fineness.

The reniform nematode increased wilt development on wilt susceptible varieties, but, unlike the root-knot and sting nematode, it did not increase the incidence of wilt on any of the wilt-resistant varieties evaluated. This occurred even though the wilt-resistant varieties were just as susceptible to the reniform nematode as the wilt-susceptible varieties.

La. Agr. Expt. Sta., Baton Rouge, La.

Hessler, L. E., Lane, H. C., and Young, A. W. COTTON FIBER DEVELOPMENT STUDIES AT SUBOPTIMUM TEMPERATURES. *Agron. J.* 51: 125-128. 1959.

Data are presented to show the effect of temperature deficiency on cotton fiber development for two crop years - 1955 and 1956.

Biochemical studies were made on cotton boll development at various ages as production of cotton moved through the boll development period. Cellulose was high and sugars were low in 21-day-old bolls when temperatures were favorable for growth. As temperature deficiency increased in the colder late season, cellulose synthesis decreased and sugars increased.

A significant correlation of temperature deficiency with sugars and cellulose in 1955 when temperatures for growth were low, and no similar correlations in 1956 when temperatures were more favorable, indicates that temperatures were a limiting factor in cotton fiber development in 1955, whereas, in 1956 other environmental factors may have been limiting.

A high ratio of cellulose to sugars occurred when temperature deficiency was low. Cotton varieties showed different ratios of cellulose to sugar under changing temperatures, indicating a more efficient development of fiber for one variety over another.

Significant correlations were found between fiber cellulose and crystallinity, and between crystallinity and strength in developing cotton over a boll period. Length of fiber in this material increased up to the 35th day of boll development. Fiber fineness showed a steady increase with boll development. The influence of low temperatures on fiber properties for a crop year was demonstrated from early to late season cotton. Evidence is presented to show that cotton fiber development may be retarded from the start of boll growth when temperature is a limiting factor.

Textile Res. Lab., Tex. Tech. Col., Lubbock, Tex.

Ray, L. L., Hudspeth, E. B., and Holekamp, E. R. COTTON PLANTING RATE STUDIES ON THE HIGH PLAINS. MP 358, 8 pp. 1959.

Cotton spacing and plant population have been studied extensively but mechanical stripper harvesting has created a need for additional information.

The purpose of this work was to find the effect of plant population on factors that might affect the performance of the mechanical stripper. Five planting rates ranging from 8 to 45 pounds per acre were tested at the Lubbock station during 1951-56.

The following effects of planting rate were found:

1. Emergence varied inversely with planting rate.

2. Lint yield differences for planting rates up to 25 pounds per acre were not significant.
3. Boll size decreased as the plant population increased.
4. Weed population was suppressed in the higher planting rates.
5. Harvest loss, amount of stems gathered by the stripper, and machine stoppages caused by large plants were less in the heavier rates of planting.
6. Plant characteristics of the higher populations were modified by increasing the height of the first branch and decreasing the plant height, the length and number of branches and the main stem diameter.

7. Total main stem weight increased, while branch weight decreased as the plant population was increased.

8. Plant population effects on the fiber characteristics were slight.

Planting rates of about 20 pounds per acre should give high stripper-harvesting efficiency, good yields and a minimum probability of having to replant.

Tex. Agr. Expt. Sta., Lubbock, Tex.

Corley, T. E., Stokes, C. M., and Kummes, F. A. MECHANIZED COTTON PRODUCTION IN ALABAMA. Agr. Expt. Sta. of the Ala. Polytech. Inst. C. 127, 27 pp. 1959.

Making more profit is the aim of every cotton farmer. To do this, ways must be found to produce the crop as cheaply as possible. Production costs is controlled by individual farmers. High labor requirements are the main reason for high production costs. About 100 man-hours are required with present production and hand-harvesting practices for an acre of cotton yielding 1 bale. With labor scarce and becoming costlier, reduction in labor requirements offer the greatest opportunity for cutting production costs.

Cutting production costs by use of machinery can help solve problems facing cotton farmers. To do this machines must be used efficiently. Results from experiments reported show that the following steps will permit efficient and profitable use of mechanized farming practices:

1. Select and prepare cotton land early.
2. Use best land for cotton and prepare it for using all types of machines.
3. Remove rocks and stumps that cause machinery breakdowns.
4. Keep terrace outlets open and drain low spots to permit earlier seeded preparation following winter rains.
5. Prepare smooth, clod-free seeded well in advance of planting time to reduce chances of late planting on poorly prepared seedbed.
6. Have tractor and planting equipment in good operating condition.
7. Adjust all units of multiple row equipment to plant alike.
8. Plant to a uniform stand to eliminate hand thinning and reduce the labor.
9. Use chemical or mechanical means to control weeds.
10. Have dusting and spraying equipment properly adjusted.
11. Defoliate rank and leafy cotton.
12. Begin picking before all cotton is open. With mechanical pickers begin when 60 to 75 percent is open.
13. Keep pickers drum clean and serviced.
14. Adjust pickers properly for efficient and clean picking.
15. Do not pick wet cotton.
16. Gin cotton soon after harvesting or make sure that only dry cotton is stored overnight in trailers.
17. Don't give up new machines or methods because of poor results during one year of unusually bad weather.

Agr. Expt. Sta., Polytech. Inst., Auburn, Ala.

Lipps, R. C., Fox, R. L., and Koehler, F. E. CHARACTERIZING ROOT ACTIVITY OF ALFALFA BY RADIOACTIVE TRACER TECHNIQUES. *Soil Sci.* 84: 195-204. 1957.

Two methods were compared for estimating the activity of plant roots at various depths in the soil. The methods involved the use of P32 tagged fertilizer which was placed at depths varying from 0 to 8 feet in (a) 36 small 1 1/4-inch auger holes drilled in plots 3 feet square, and (b) nine 3-inch orchard auger holes drilled in plots 3 feet square. Root activity of subirrigated alfalfa was estimated at the various depths throughout the growing season by measuring P32 in the terminal growth of plants sampled at random within the plots. The two methods of placement used gave similar results. Three zones of root activity were found: (a) surface soil where activity was high in the spring but decreased during the dry weather of summer and fall, (b) zone of minimum activity in unfavorable chemical environment between 2 and 4 feet, and (c) zone of secondary activity in moist soil above the water table.

Nebr. Agr. Expt. Sta, St. Paul, Minn.

Bennett, Hugh W. THE EFFECTIVENESS OF SELECTION FOR THE HARD SEDED CHARACTER IN CRIMSON CLOVER. *Agron. J.* 51: 15-16. 1959.

The permeable seed coat of common crimson clover permits rapid water absorption and induces immediate germination at a moisture level too low for subsequent seedling establishment or survival. This may occur any time after the seed is mature. This circumstance has been the predominant cause of most failures to obtain satisfactory fall stands.

The hard seed from 120 pounds of composited common crimson clover seed from 42 sources was planted at the Natchez and North Mississippi branch stations and at the central station at State College.

In 9 years of successive selection by the water-soak screening technic, the average percentage of hard seed was increased progressively from 1.0% for the common stock to 4, 12, 16, 43, 48, 49, and 63%, consecutively.

The selection for the hard seeded character in crimson clover as described led to the development of the variety Chief.

Miss. Agr. Expt. Sta., State College, Miss.

Donnelly, E. D., Langford, W. R. WARRIOR VETCH--A NEW VARIETY FOR ALABAMA. *Ala. Polytech. Inst. L.* 62. 1959.

Warrior Vetch (*Vicia sativa*) is a composite of five lines selected for seed and herbage production and cold tolerance. These lines were selected in 1951 and 1952 and tested until 1954. They were then composited to form an experimental variety.

Warrior is similar to Willamette in appearance, cold tolerance, and herbage production, but produces higher seed yields under Alabama conditions. Warrior does not shatter readily. Although it produces some volunteer plants, it cannot be depended upon to reseed itself.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Pasture and Range

Johnson, W. M., GRAZING INTENSITY TRIALS ON SEDED RANGES IN THE PONDEROSA PINE ZONE OF COLORADO. *J. Range Mangt.* 12: 1-7. 1959.

Seeding ranges for the improvement of forage values is now a recognized practice. Depleted ranges and abandoned farmlands in the ponderosa pine zone of Colorado can be successfully seeded.

The Rocky Mountain Forest and Range Experiment Station conducted a study to determine the proper degrees of grazing use on some of the more important grasses used in seeding. The study was made from 1946 to 1956 at the Manitou Experimental Forest, 28 miles northwest of Colorado Springs, Colorado.

The yield of herbage can be increased manyfold and may be increased 3 to 5 times over that of good adjoining native range. Grazing capacities and beef production are also greatly increased. Successful seeding of a few acres of land may thus be sufficient to fill existing gaps in the yearlong feed program for livestock. It may provide needed forage for spring or fall use, or supplement summer grazing lands, or furnish additional hay for winter feeding.

Crested wheatgrass was grazed to a 2-inch stubble height without seriously injuring the ability of the grass to grow and produce normal amounts of herbage. At this rate of grazing, there was some reduction in the initial growth rate, but this was apparently overcome during the growing season and was not reflected in total herbage yields. Grazing crested wheatgrass to 4- or 6-inch stubble heights was not efficient from the standpoint of beef production and presented problems in uneven use of the forage. The relation of these grazing intensities to longtime range maintenance was not determined, but it was observed that the 2-inch stubble left very little litter for maintaining good soil conditions.

A 4-inch stubble should be left on smooth brome. Closer grazing injures the plants. Vigor, as measured by early leaf growth, is reduced and herbage yields are lowered.

Intermediate wheatgrass is injured quickly and seriously when grazed during the spring and summer to a 2-inch stubble height. Plant vigor as measured by initial height growth and herbage yields was greatly reduced after only 2 years of grazing to this intensity. Grazing to a 4-inch stubble height did not appear to injure the plants.

Only 6 years of record are available for interpreting results on Russian Wildrye, but so far grazing to a 1 1/2-inch stubble height has had little effect on herbage yield and, therefore, little effect on stocking rates.

Rocky Mountain Forest & Range Expt. Sta., Fort Collins, Colo.

Thatcher, Albert P. DISTRIBUTION OF SAGEBRUSH AS RELATED TO SITE DIFFERENCES IN ALBANY COUNTY, WYOMING. J. Range Mangt. 12: 55-61. 1959.

A major purpose of this study was to determine if differences in species and growth forms in Albany County, Wyoming, could be related to differences in soil characteristics such as depth, texture, permeability, alkalinity, salinity, and wetness. Other characteristics considered were parent or underlying material of the soil, topographical position, and climatic belts as they might influence the species of sagebrush adapted to the site.

Four species of sagebrush have ranges which include the area studied in Albany County, Wyoming. Local distribution of each species was associated with factors of the physical environment as follows:

1. Big sagebrush (*Artemesia tridentata*), of the four species studied, was found over the greatest variety of site conditions. Within this species there are different growth forms associated with differences in soil and water relationship of different types of sites. This was the only species that grew on soils with dense, heavy textured subsoils and on soils underlain by shale.

2. Silver sagebrush (*Artemesia cana*) was most often found on lowlands, but it also occurred in upland sites where topsoils were sandy and subsoils were at least moderately permeable to movement of water and air. This species was the only one of the four studied which grew where water tables occurred within the root zone. Soil mottling, indicating incomplete oxidation, was frequently evident in the root zone of this species. It did not occur on soils underlain by shale or granitic bedrock within the root zone.

3. Black sagebrush (*Artemesia nova*) was found only on the uplands, where it occurred on shallow and very shallow soils. The soil depth exceeded 20 inches in only two of the 12 sites studied. This species did not occur on soils underlain by shale or sandstone but instead on soils underlain by gravel or granitic bedrock.

4. Threetip sagebrush (*Artemesia tripartita*) was the only species which occurred entirely within the higher precipitation belt and higher elevations of the study area.

It occurred only on soils underlain by granitic bedrock or gravel adjacent to and derived from the granites. It also was the only species restricted to soils where the reaction in all cases was less than pH 7.3.

SCS, ARS, USDA, Laramie, Wyo.

Schmutz, Ervin M., Cable, Dwight R., and Warwick, John J. EFFECTS OF SHRUB REMOVAL ON THE VEGETATION OF A SEMIDESERT GRASS-SHRUB RANGE. J. Range Mangt. 12: 34-37. 1959.

In June 1955 an area of 1,580 acres of semidesert grass-shrub vegetation on the Papago Indian Reservation in southern Arizona was chained.

The area was chained early in June before the summer rains began. The chaining technique consisted of pulling an anchor chain looped between two crawler-type tractors, in one direction only. Before chaining the area was seeded by airplane at a rate of 1 1/2 pounds per acre to a mixture of Boer lovegrass (*Eragrostis chloromelas*) and Wilman lovegrass (*E. superba*). The area has been protected from grazing by domestic livestock since chaining.

Two and a half years after treatment, basal intercept of perennial grasses was measured, and numbers of forbs and shrubs per acre were counted on a portion of the chained area and on an adjacent unchained area to evaluate the effect of chaining.

In general, the most obvious effect of the chaining operation was to open up the shrub stand by knocking down the woody plants. However, due to the large number of young cholla plants established following the chaining treatment, the opening up of the area appears to be only temporary, and the future stand of mature cholla will probably be much more dense than the original stand.

Native perennial grasses did not benefit noticeably from the chaining treatment, and reseeded lovegrasses failed to become established.

Some shrubby species, such as young jumping cholla and burroweed, increased in abundance, while others, such as old jumping cholla and pencil cholla, decreased in abundance following chaining.

The results of this study indicate that control of jumping cholla by chaining on semi-desert ranges in southern Arizona will not be effective until a method is developed for preventing the establishment of new plants from fallen joints.

U. Ariz., Tucson, Ariz.

Lewis, R. D. MOUNTAIN MEADOW IMPROVEMENT IN WYOMING. Wyo. Agr. Expt. Sta. B. 350. May 1957.

Research results and rancher experience show that there are four major steps involved in the improvement of hay and pasture production in the mountain meadows of Wyoming.

Water Control Essential: Top production is not possible under the wild-flooding irrigation method that is used on many mountain-meadow ranches. Field results show that intermittent rather than continuous wild-flood irrigation is necessary to establish and maintain good stands of high-yielding forage species. The highest profits from nitrogen fertilizer and the most efficient water use on either deep or shallow soils has been obtained with intermittent irrigation. A general recommendation for maximum yield of high quality hay is to irrigate by applying 1 to 3 inches of water over a period of 1 to 8 hours, depending on soil depth and texture at 2-week intervals at the beginning of the season and at 1-week intervals during the peak of the growing season. The peak growing season usually occurs from mid-June to the end of July, depending on the location.

Establishment of Higher-Yielding Forage Species: Ranchers can establish higher-producing forage species in several ways, depending upon soil depth. In areas with relatively deep surface soils, the meadows can be plowed, leveled, and seeded. In most cases it is desirable to grow an annual crop such as oats, or oats and peas, for one to three years, to allow the sod to decompose and to permit final leveling and seedbed preparation. In shallow soils with just a few inches of topsoil overlying gravel, plowing and leveling are not desirable, and the rancher must resort to renovation or broadcast methods to incorporate higher-producing forage species.

Nitrogen Fertilization Shows Promise: Nitrogen fertilization has given large increases in yield and quality of hay when used with higher-yielding forage species and adequate water control. When considering only hay tonnage, the 80-pound nitrogen applications gave the most economical returns. However, when protein content was also considered, the 160-pound rate of nitrogen paid best.

Time of Harvest Important: The highest yields of high-protein hay are obtained when higher-producing forage species are cut not later than when the seed is at soft-dough stage. As the forage species mature, crude protein declines and the hay becomes coarse and low in palatability. When grass forage is cut before or during the soft-dough stage and fertilized with high rates of nitrogen, most species will produce aftermath growth high in protein if proper irrigation and soil management practices are used. This aftermath can be cut for hay or pastured later in the summer or in the fall.

Wyo. Agr. Expt. Sta., Laramie, Wyo.

Leithead, Horace L. RUNOFF IN RELATION TO RANGE CONDITION IN THE BIG BEND-DAVIS MOUNTAIN SECTION OF TEXAS. J. Range Mangt. 12: 83-87 1959.

Runoff is increased in the Davis Mountain-Big Bend area as ranges deteriorate in range condition because the soil absorbs moisture slower. A range site in good condition absorbs moisture five to six times faster than the same range site in poor condition.

The loss of moisture by evaporation from the first foot of soil is about three times greater on closely grazed, poor condition range than it is from the same sites in good condition that have been properly grazed. Moisture lost to evaporation can be just as serious as moisture lost by runoff, even though it is less noticeable.

Runoff from the local thunder storms does not leave the watershed even though it leaves the area on which the rains fall. This runoff is absorbed in the dry beds of the arroyos, and very seldom reaches the gaging stations at the mouths of these drainages.

A greater percentage of the annual precipitation in this section of Texas can be held where it falls by improving the condition of the range. Local runoff can be reduced and production increased; yet, because of the rainfall pattern it is doubtful that the amount of water that leaves a watershed as large as these drainages can be reduced greatly by improving the condition of the range.

SCS, ARS, USDA, Ephrata, Wash.

Stickler, F. C., and Johnson, I. J. DRY MATTER AND NITROGEN PRODUCTION OF LEGUMES AND LEGUME ASSOCIATIONS IN THE FALL OF THE SEEDING YEAR. Agron. J. 51: 135-137. 1959.

Madrid sweetclover excelled in dry matter and nitrogen production in the fall of the seeding year. Southern, nonhardy alfalfas were superior to the hardy strain, Ranger. Higher yields were obtained from medium red clover than from Ladino white clover, but both were inferior to other legumes. Madrid sweetclover grown alone outyielded the various legume associations. Madrid was the major component of all associations in which it was included. Red clover and Ladino white clover lacked strong competitive ability under these conditions.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Schultz, E. F. Jr., Langford, W. R., Evans, E. M., Patterson, R. M., and Anthony, W. B. RELATIONSHIP OF BEEF GAINS TO FORAGE YIELDS. Agron. J. 51: 207-211. 1959.

Results of 3 grazing experiments, involving 9 location-years, were examined statistically to determine the relationship between beef gains and forage yields. In these experiments, thin yearling animals were used with frequent adjustment of stocking rate to utilize the forage optimally. A rather wide range of forage species and fertilizer treatments were included, as well as irrigation and different harvesting methods for estimating forage yields. Some exceptional long-season treatments were involved, but, in fitting

the relationships, only data from the main grazing season, spring and summer, were used. A curvilinear relationship of beef gain per acre to forage yield per acre was found. The curve was not significantly different in shape among the nine location-years, but the general level of beef production at a given forage yield differed from location-years.

The relationship can be used to estimate differences in beef production of treatments compared in the same experiments and years although absolute level of beef production cannot be estimated. The equation to estimate differences (D) was found to be:

$$D = 0.071,18 (\bar{X}_1 - \bar{X}_2) - 0.000,001,732 (\bar{X}_1^2 - \bar{X}_2^2), \text{ where } \bar{X}_1 \text{ and } \bar{X}_2$$

are the annual acre yields of oven dry forage per acre attributable to the two treatments.

This relationship would seem to be applicable in regions similar to the southeastern United States for estimating beef yields from yields of warm season forages determined by caging and clipping plots exposed to grazing, where it is contemplated utilizing the forage with thin yearling animals, and it is expected that the forage intake per animal will be satisfactory when the forage is offered as the only feed.

ARS, USDA, New Orleans, La.

Honnas, R. C., Branscomb, B. L., and Humphrey, R. R. EFFECT OF RANGE FERTILIZATION ON GROWTH OF THREE SOUTHERN ARIZONA GRASSES. J. Range Mangt. 12: 88-91. 1959.

A study was made of the effects of range fertilization on several growth characteristics of three native forage grasses in southern Arizona. Ammonium phosphate in granular form was applied at rates of 100, 250 and 400 pounds per acre. The fertilizer remained on top of the soil for approximately 6 months before precipitation was adequate to leach it down.

The growth response to this fertilization by blue, hairy and sideoates grama was extremely varied.

There was no difference in the time of beginning growth on treated and untreated plots. Subsequent to growth initiation, however, grasses on the fertilized areas made more rapid growth than those that were not fertilized. The date of range readiness was advanced and length of the green-feed period was increased for blue and hairy grama under all levels of treatment. The green-feed period was lengthened from 2 to 4 weeks for blue grama, and 2 to 6 weeks for hairy grama. Range readiness of sideoats grama was not affected, and fertilization at the high and medium levels appeared to reduce the green-feed period of this species by 2 weeks.

All species on the fertilized areas initiated flowering earlier, and remained in the flowering stage longer than the untreated plants. All species at the high level of treatment set seed at the same time as those on the controls; they were followed by those on the low level and medium level of treatment respectively. With the exception of hairy and sideoats grama at the medium level of fertilization, all species increased total forage production over the controls under all levels of treatment.

It appears that adequate precipitation immediately following application of the fertilizer is essential to obtaining the optimum benefits from range fertilization.

U. Ariz., Tucson, Ariz.

Moldenhaurer, William C. ESTABLISHMENT OF GRASSES ON SANDY SOIL OF SOUTHERN HIGH PLAINS OF TEXAS USING A MULCH AND SIMULATED MOISTURE LEVELS. Agron. J. 51: 39-41. 1959.

This experiment was designed to determine the need for a mulch covering the seeded area for emergence of seven species of grass grown on the sandy soils of the southern High Plains of Texas. It was found that a mulch covering the seeded area increased the number of seedlings under high moisture conditions. On the low moisture treatment, almost no seedlings emerged unless a mulch covered the seeded area. The difference in

effect of mulching was much more pronounced in 1955 when temperatures were very favorable for growth than in 1956 when the temperatures were about 20 degrees cooler at the beginning of the experiment.

Applying the results to two locations by means of weather records, it was found that at Big Spring, Texas, in 10 of 42 years moisture was low in April and May, but a mulch would have assured emergence. In all except one of these years there is a chance that seeds would have germinated without a mulch. In 31 of the years, a mulch would have been unnecessary because of favorable moisture conditions, and in one year moisture was too low for any emergence.

At Seminole, Texas, where annual rainfall is 2.5 inches less than at Big Spring, in 8 of 25 years moisture was low in April and May, but a mulch would have assured germination. In 5 of these years, however, there is a chance that seeds would have germinated without a mulch. In 15 of the years a mulch would have been unnecessary because of favorable moisture conditions, and in 2 years moisture was too low for any emergence.

SWC, ARS, USDA, Ames, Iowa.

Jackson, James E., Walker, Milton E., and Carter, Robert L. NITROGEN, PHOSPHORUS, AND POTASSIUM REQUIREMENTS OF COASTAL BERMUDAGRASS ON A TIFTON LOAMY SAND. *Agron. J.* 51: 129-131. 1959.

An experiment was conducted from 1951 through 1956 at Tifton, Georgia, to study the effect of varying fertilizer rates and ratios on the production of Coastal bermudagrass growing on a Tifton loamy sand. An analysis of the data to include yield, chemical composition of the forage, and soil test results led to the following conclusions:

1. The available phosphorus and potassium in the soil were depleted when they were omitted from the fertilizer applied. The rate of depletion increased with increasing rates of nitrogen application.

2. There was no yield response to applied potassium at any N rate the first year of the test. Potassium became the limiting factor in the second year on those plots receiving annual applications of 400 and 800 pounds of nitrogen per acre and no potash.

3. There was no yield response to applied phosphorus at any N rate until the fourth year of the experiment.

4. The induced phosphorus deficiencies were corrected the first year after applying sufficient phosphorus to raise the soil level to approximately 75 pounds of available P_2O_5 per acre and then applying a 4-1-2 ratio based on the N rates used, from 200 to 800 pounds per acre. A 3-1-2 ratio was used for the 100-pound N rate.

5. The induced potassium deficiencies were corrected after applying sufficient K_2O to raise the soil level to approximately 100 pounds of available K_2O per acre and then applying a 4-1-2 or 3-1-2 ratio for two successive years.

6. It appears that the available soil phosphorus and potassium may fall to very low levels before a resultant yield reduction of Coastal bermudagrass would be observed in field plantings. Periodic soil testing is an invaluable tool in determining the amount and ratio of P and K needed for a given management system.

7. For most soils similar to those of the test area, a maintenance fertilizer ratio for Coastal bermudagrass hay production should contain at least 1 unit of P_2O_5 and 2 units of K_2O for each 4 units of nitrogen.

Coastal Plain Expt. Sta., Tifton, Ga.

Cooper, C. S., and Hunter, A. S. A LEGUME FOR NATIVE FLOOD MEADOWS: II. PHOSPHORUS FERTILIZER REQUIREMENTS FOR MAINTAINING STANDS OF WHITE-TIP CLOVER (*TRIFOLIUM VARIEGATUM*). *Agron. J.* 51: 350-352. 1959.

Phosphorus fertility requirements for maintaining stands of white-tip clover in native flood meadows were studied in a factorial experiment over a 3-year period. Yield, protein content, and phosphorus content of hay were measured, each year.

Annual applications of 40 pounds of P_2O_5 per acre resulted in nearly maximum yields of mixed clover-rush sedge hay. Residual phosphorus was adequate for plant growth only when 120 pounds of P_2O_5 per acre or more had been applied in the previous year.

Phosphorus content of hay increased in proportion to the amount of P_2O_5 applied. Nearly maximum yields were obtained when the phosphorus content of hay was between 0.20 and 0.23%. A phosphorus content of this magnitude is realized with annual applications of 40 pounds of P_2O_5 per acre.

Phosphorus fertilization increased crude protein indirectly as a result of an increased proportion of clover in the hay. Differences in the proportions of clover in the hay were marked among years and were related to early spring temperatures and flood conditions.

Mont. State Col., Bozeman, Mont.

Baltnsperger, A. A., and Kalton, R. R. VARIABILITY IN REED CANARYGRASS, *PHALARIS ARUNDINACEA* L. II. SEED SHATTERING. *Agron. J.* 51: 37-38. 1959.

Variation for seed shattering among 12 clonal selections of reed canarygrass, (*P. arundinacea* L.) was measured in a replicated, vegetatively-propagated field experiment using a method for measuring seed shattering irrespective of bloom date. Measurements of relative seed shattering among the 12 clones revealed inherent differences within this species for this attribute. One selection was found to hold a high percentage of its seed up to 40 days after bloom, while selections similar to commercial reed canarygrass lost nearly all seeds within 25 days.

U. Ariz., Tuscon, Ariz.

Donnelly, E. D. THE EFFECT OF SEASON, PLANT MATURITY, AND HEIGHT ON THE TANNIN CONTENT OF SERICEA LESPEDEZA, L. CUNEATA. *Agron. J.* 51: 71-73. 1959.

Tannin in sericea aftermaths increased as the season advanced. Tannin content increased concurrently with a rise in temperature and a decrease in rainfall. Tannin content increased with maturity. Plant height was not associated with tannin content.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Cronemiller, Fred P. THE LIFE HISTORY OF DEERBRUSH-A FIRE TYPE. *J. Range Mangt.* 12: 21-25. 1959.

Deerbrush is rather typical of many species that comprise fire types. It occurs most commonly in dense stands in the ponderosa pine belt where fire has destroyed the forest. It regenerates almost solely after fire or some violent soil disturbance such as logging or road construction. Although not resistant to abuse during its first year or two, thereafter it rarely is killed by any mechanical treatment above the soil surface, and this includes grazing.

It produces a large volume of foliage from the third to the tenth year and sometimes later. Thereafter much of the foliage is beyond the reach of livestock. Any invading conifer reproduction may begin to overtop the plants at this time, and by the twentieth year the shrubs will be shaded out where a full canopy of conifers develops.

The life span of the plant is about 35 years, whether it is ungrazed or badly abused. It produces an abundance of seed, yet practically none germinates until fire opens the hard coat or mechanical disturbance scarifies it.

Because grazing capacity fluctuates during the life of the shrubs, the deerbrush type is not one upon which you can develop an economy. Much of the land it occupies is most valuable for timber production. Where deerbrush is in full sun, its useful life may be extended by 20 years at least by coppicing, and this practice appears economic because of the high grazing capacity of full stands. It is worth remembering, however, that fire types are dynamic vegetational complexes. They cannot be described by observations over a single year. Management and use must be in terms of their whole life history. We have hardly begun to study fire types as such complexes.

USDA, San Francisco, Calif.

Hawkins, George E., Smith, L. A., and Kelley, W. B. A COMPARISON OF STARR MILLET, SWEET SUDANGRASS, JOHNSONGRASS AS DAIRY FORAGES.
Ala. Polytech. Inst. L. 60. 1958.

Chemical composition of the Johnsongrass, Starr millet, and sweet Sudangrass grazed at the Black Belt Substation and fed green at the Main Station was determined. Composition of all three was similar except that Starr millet was highest in fat and lowest in nitrogen-free extract (sugar and starch) content.

Under proper management, Johnsongrass, sweet Sudangrass, and Starr millet are high quality forages for dairy cows. Proper management means keeping the pastures about 15 inches high and leafy. This can be done by: (1) Waiting until the pastures are 15 to 18 inches high before turning the cows onto them; (2) adding dry cows when the pastures are making fast growth; (3) having two or three pastures and changing at 10-day to 2-week intervals when growth is slow; and (4) by staggering the planting dates of the two annuals - sweet Sudangrass and Starr millet. The acreage needed to supply good grazing throughout the summer months will vary from farm to farm. Natural fertility of the soil, amount of fertilizer applied and amount of rainfall determine acreage needed.

At similar stages of growth, Johnsongrass, sweet Sudangrass, and Starr millet were about equal as feed for milking cows. The stage of maturity at which these three grasses were grazed was more important than the grass species. For this reason, any one or a combination of these three grasses that is best suited to a farm can be used to provide forage for milking cows during the summer months in Alabama.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Knight, W. E., and Hollowell, E. A. THE EFFECT OF STAND DENSITY ON PHYSIOLOGICAL AND MORPHOLOGICAL CHARACTERISTICS OF CRIMSON CLOVER.
Agron. J. 51: 73-76. 1959.

Every year, clover in dense stands produced earlier fall and winter growth and greater forage yields than that in thin stands. On November 29, 1955, the clover in the 3/4-inch spacing averaged 5.14 inches in height, whereas, that at the 6-inch spacing averaged 0.7 inch. On December 5, 1956, the clover at a 3/4-inch spacing produced an average of 10, 634 pounds on green matter per acre with a dry matter content of 18.3%, while a somewhat similar yield for 6-inch spacing did not occur until March 1.

Stand density had a marked effect on the number of vegetative stems and the number of seed heads produced by crimson clover. Seed heads per plant averaged 1.1 and 15.7 for the 3/4- and 6-inch spacings, respectively, and stems per plant averaged 1.5 and 18.7 for the same treatments. Seasonal variation apparently affected height at maturity and number of florets per head as much as did stand density.

In general, an increase in stand density produced an increase in total forage yield. In 1955-56, the clover at 3/4-inch spacing averaged 4,013 pounds of dry matter per acre more and 158 pounds of seed per acre less than that at the 6-inch spacing.

Dense stands of crimson clover were damaged by *Sclerotinia trifoliorum* when the forage was not clipped. In 1956-57, clipping the forage controlled the disease during the growing season. Total dry forage yields were reduced an average of 609 pounds per acre by clipping and seed yields were reduced an average of 89 pounds per acre. Forage from the clipped plots was of much higher quality than that from the unclipped plots.

Miss. Expt. Sta., State College, Miss.

Hawkins, G. H., and Autrey, K. M. YOUNG OAT FORAGE A HIGH QUALITY DAIRY FEED. Ala. Polytech. Inst. L. 55. 1957.

A test was made to determine the reasons for greater milk flow by cows on young oat forage as compared with milk yields from cows on hay.

Results of these experiments show that young green oat forage is a very high quality feed for milk cows. Cows eating this kind of forage can produce more milk than when alfalfa hay is the only forage fed.

Dairymen with limited acreage of oat pasture may get near peak milk production by grazing their cows for a short time each day and feeding them all of the high quality hay they can eat.

Results of these studies show that cows will eat more nutrients when their rations contain some green oat forage than when alfalfa hay is the only roughage. Probably this is due in part to the relatively large amount of bulk (mainly fiber) in the hay, and to the high digestibility of the young oats. Also, there appears to be something present in young oat forage that increases the ability of the cow to use more nutrients for milk than when hay is the source of roughage. Nevertheless, the amount of nutrients required to produce a pound of milk seems to be about the same from alfalfa hay as from immature oat forage.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Johnson, Walter., McKell, Cyrus M., Evans, Raymond A., and Berry, L. J. YIELD AND QUALITY OF ANNUAL RANGE FORAGE FOLLOWING 2,4-D APPLICATION ON BLUE OAK TREES. J. Range Mangt. 12: 18-20. 1959.

A field trial was established in blue oak-annual grassland to measure the quantity and quality of forage produced after killing blue oak trees using undiluted 2,4-D amine in a cut surface application technique.

Treatment resulted in a five-fold increase in forage yield. Quality of forage with respect to crude protein and phosphorus content was not affected by the treatment.

Further study is underway to identify the particular factors responsible for greater plant growth under a canopy of dead blue oak trees vs. a canopy of live trees.

ARS, USDA, Davis, Calif.

Weed, Brush, and Pest Control

Graham, Samuel A. CONTROL OF INSECTS THROUGH SILVICULTURAL PRACTICES. J. Forestry 57: 281-283. 1959.

The principal silvicultural practices that help control insects are: diversification; fitting the trees to the site; preventing stagnation; light protective overstory; site preparation; maintaining high density, and removal of high risk trees.

Such control requires advance planning. It requires that a forest manager be trained to recognize the potentially dangerous insects that live in his locality and to understand their preferences. He must be able to recognize trees and stands that have attained a state susceptible to attack and injury by these insects. He must be able to arrange his cutting compartments in order of hazard, so that he can plan for their logging in order of susceptibility or, if an outbreak should arise, for their prompt salvage. He should also set up a system of annual examination of critical areas so that the need for salvage may be anticipated. And he must provide an adequate system of permanent access and haul roads so that needed operations can be conducted regardless of their location. Where these requirements have been met, the control of insects through silviculture can be realized.

Sch. of Natl. Resources, U. Mich., Ann Arbor, Mich.

Huffaker, C. B., and Kennett, C. E. A TEN-YEAR STUDY OF VEGETATIONAL CHANGES ASSOCIATED WITH BIOLOGICAL CONTROL OF KLAMATH WEED. J. Range Mangt. 12: 69-82. 1959.

Klamath weed, prior to 1949, was estimated to infest 2 1/3 million acres of valuable rangeland in northern California. The failure of other solutions prompted the late H. S. Smith to initiate biological control. In 1947, a ten-year study was begun on control of this weed by imported beetles, primarily Chrysomela quadrigemina (Rossi), relative to degree of control and range plant composition. The data show that a major improvement in the ranges resulted. Control was more effective than hoped for even by enthusiasts.

The weed now exists at less than 1 percent of its former occurrence. There was concurrent marked increase in perennial grasses, chiefly California oatgrass in Humboldt County, and there and elsewhere the winter annuals--grasses, legumes and forbs--of fair to good forage value claimed a major portion of the space opened up by decline of Klamath weed. This low level of the weed constitutes no loss whatever, except as it may occasion premature intervention to eradicate it locally.

Agr. Expt. Sta., U. Calif., Berkeley, Calif.

Robinson, R. G., and Dunham, R. S. PRE-PLANTING TILLAGE FOR WEED CONTROL IN SOYBEANS. *Agron. J.* 48: 493-495. 1956.

Tillage of plowed ground before final preparation of seedbed for soybeans appeared to be ineffective as a control against several species of weeds.

U. Minn., St. Paul, Minn.

Langley, Philip G. AERIAL PHOTOGRAPHY AS AN AID IN INSECT CONTROL IN WESTERN PINE AND MIXED CONIFER FORESTS. *J. Forestry* 57: 169-172. 1959.

The problem of controlling losses from various forest insects is becoming increasingly important in the western pine and mixed conifer forests of the United States. The early detection of these insect attacks is a prime need in gaining control over these losses.

Specialized types of aerial photography are useful and economically practical as a supplement to existing air and ground methods in cases where control measures or salvage operations are to take place. Color photography at suitable scales gives consistently good results if properly used, provide a wealth of detail, and can be very effectively used in saving important time as well as substantially cutting ground costs.

With these developments in mind, it might be well for the forest manager to consider using this additional tool to help enable him to obtain the maximum financial return from his forest land.

Airview Spec. Corp., Pleasant Hill, Calif.

Waters, W. E., Heller, R. C., and Bean, J. L. AERIAL APPRAISAL OF DAMAGE BY THE SPRUCE BUDWORM. *J. Forestry* 56: 269-276. 1958.

Two methods--direct aerial observation and airphoto interpretation have been tested and compared. Both are useful, but accuracy depends greatly on the skill and experience of the personnel used.

1. Light defoliation of balsam fir by the spruce budworm, characteristic of the early stages of an outbreak, can be seen and accurately appraised by direct scanning from a flying height of 500 feet and a speed of approximately 90 miles per hour. The detection and assessment of light defoliation from aerial color photographs of a scale approximating 1:3960 is less certain and less reliable.

2. For budworm defoliation surveys, the aerial observation method is more economical as well as more accurate than the airphoto interpretation method. Moreover, it allows more latitude weatherwise in carrying out a survey. It is particularly advantageous where a large area is involved.

3. For quantitative appraisal of top-killing and tree mortality of balsam fir (by spruce budworm or other agents), the photographic method is capable of providing the more accurate data. Its accuracy might be increased by color photographs of larger scale than 1:3960 or by use of newly developed high shutter speed cameras and color films with superior image resolution.

4. The accuracy and consistency of aerial and photo appraisals of budworm damage are definitely enhanced by experience in aerial observation and photo interpretation and also familiarity with the insect.

5. Use of orange filter masks is strongly recommended for the detection and assessment of budworm damage from the air. Masks are particularly helpful in spotting dead tops and dead trees.

6. Supplementary ground surveys are requisite for proper interpretation of aerial observations. Data should be taken of the insect population, defoliation, tree damage, and insofar as possible, the status of natural enemies, particularly parasites and disease. These ground observations need not be extensive.

Forest Insect Lab., USDA, Beltsville, Md.

Graham, Donald P. RESULTS OF POLE BLIGHT DAMAGE SURVEYS IN THE WESTERN WHITE PINE TYPE. *J. Forestry* 56: 652-655. 1958.

A sample-plot survey to determine the damage caused by the pole blight disease and its effect on the stand was made in the western white pine type.

The results of this survey confirm that pole blight is a serious problem in the western white pine type. The past and current level of damage, as determined from the survey, has caused and is continuing to cause a serious reduction in productivity. Pole blight damage in many affected stands greatly exceeds growth and thus under current conditions will eliminate white pine as a commercially important species in these stands in a relatively short time.

Intermountain Forest and Range Expt. Sta., Spokane, Wash.

Dick, James, Finnis, J. M., Hunt, Lee O., and Kverno, Nelson B. TREATMENT OF DOUGLAS-FIR SEED TO REDUCE LOSS TO RODENTS. *J. Forestry* 56: 660-661. 1958.

A cooperative factorial experiment was conducted in British Columbia, Washington, and Oregon on direct seeding of Douglas-fir. A total of 36 0.1-acre plots were broadcast at the rate of one pound per acre with endrin-coated seed. The addition of the fungicide Arason 75 to the endrin coating proved unnecessary. The substitution of Dow Latex 512-R for methocelrhoplex as the binder proved satisfactory. Outcome was measured by first-season stocking which averaged 2,610 seedlings per acre. This indicates satisfactory rodent control by the endrin coating and, with reasonable survival, should prove adequate reproduction.

Weyerhaeuser Co., Box A, Tacoma, Wash.

Jokela, J. J., and Lorenz, Ralph W. MOUSE INJURY TO FOREST PLANTING IN THE PRAIRIE REGION OF ILLINOIS. *J. Forestry* 57: 21-25. 1959.

Rabbits and mice have been the chief factors limiting early success of the State 4-H Memorial Camp and the Illini Forest Plantations in central Illinois. Ten years of observations of mouse injury, principally by the prairie meadow mouse, are reported.

Ash, Cottonwood, Douglas-fir, larch, Osage-orange, yellow-poplar, and southern pines, with the exception of loblolly pine, were severely injured at one or both locations. Rating of species according to their relative susceptibility to mouse injury, however, would be difficult because of the variable nature of injury with location and time.

Injury to pine or hardwoods during the first winter following planting generally resulted in death. Mortality among pine trees injured at older ages was confined to trees having had more than 75 percent of their stems girdled at the groundline and generally occurred within a year after injury. Dieback of established hardwoods from mouse injury usually was followed by sprouting, frequently resulting in multiple stems. Growth reduction varies with the degree of injury. This reduction was most pronounced in the first growing season following injury, after which it diminished rapidly.

Clean cultivation does lessen mouse injury, but it is costly and impractical in many forest plantations. Poisoning, to be effective, should be applied prior to the advent of cold weather.

U. of Ill. Agr. Expt. Sta., Urbana. Ill.

Speers, C. F. PALES WEEVIL RAPIDLY BECOMING SERIOUS PEST OF PINE REPRODUCTION IN THE SOUTH. J. Forestry. 56: 723-726. 1958.

The Pales (Hylobius pales) and pitch-eating weevils (Pachylobius picivorus) are rapidly becoming serious pests in the South. Weevils are attracted to areas where recent cutting or weakening of pines has occurred, and in these areas they feed on the bark of young pine seedlings, causing injury or death.

Pales weevils are attracted to recently cut areas, and are doing heavy damage to areas planted immediately after harvest. Burning cutover areas did not effectively lessen beetle activity. Recent tests showed that the following methods of control were successful: (1) if competition is not too severe, wait at least 9 months before planting; (2) immerse tops of seedlings in insecticide prior to planting; (3) apply granular insecticide to soil around each dipped seedling; (4) spray seedlings and surrounding soil.

Southeastern Forest Expt. Sta., USDA., Asheville, N. C.

Hall, Ralph C. SANITATION-SALVAGE CONTROLS BARK BEETLES IN SOUTHERN CALIFORNIA RECREATION AREA. J. Forestry 56: 9-11. 1958.

Entomologists and foresters have shown that insect depredations can be effectively suppressed through sanitation-salvage logging without damaging an area for recreational use. This conclusion is substantiated by the results of a test in the heavily used Barton Flats Recreational Area of the San Bernardino National Forest. In the test, infested trees and those considered to be most susceptible to insect attack and damage were cut and utilized for lumber. Yet scenic and recreational values of the forest were maintained.

Forest Serv., USDA, Berkeley, Calif.

Smyth, Arthur V. THE DOUGLAS-FIR BARK BEETLE EPIDEMIC ON THE MILLICOMA FOREST: METHODS USED FOR CONTROL AND SALVAGE. J. Forestry 57: 278-280. 1959.

The Millcoma Forest is an industrial tree farm of the Weyerhaeuser Timber Company located in the Coast Range of Southwestern Oregon.

Most of the forest consists of a dense, even-aged stand of almost pure Douglas-fir 180 years old. Understory western hemlock and western redcedar make up the remainder.

This forest property was hit by an epidemic of the Douglas-fir bark beetle (Dendroctonus pseudotsugae Hopk.). The losses from the windthrow, which preceded the insect attack, and from the beetle itself were extremely heavy. The purpose of this paper is to report briefly what was done in attempting to control the beetle population and how the immense job of salvage was handled.

The author draws the following conclusions:

1. Large, unbroken areas of pure, even-aged stands are particularly vulnerable to insect attack. Knowing this, all such areas should be tapped with a network of logging and access roads to the greatest extent practicable.
2. Systematic survey methods should be so organized that any insect build-up can be promptly detected and located.
3. Prompt sanitation cutting and salvage of dead and dying trees, blowdown, and right-of-way logs will help prevent the build-up of bark beetle populations. Silvicultural control is the only practical means we presently have for the control of the Douglas-fir bark beetle.

4. In general, ten years is about the maximum time available for salvage.

Coos Bay Br., Weyerhaeuser Timber Co., Coos Bay, Oreg.

Smith, R. H. CONTROL OF THE TURPENTINE BEETLE IN NAVAL STORES STANDS BY SPRAYING ATTACKED TREES WITH BENZENE HEXACHLORIDE. J. Forestry 56: 190-194. 1958.

A properly executed and maintained program of spraying attacked trees will markedly reduce the activity of the black turpentine beetle. The spray is a 1 percent BHC gamma isomer solution in diesel oil or No. 2 fuel oil.

In the tests conducted there was a 90 percent reduction in tree mortality, which was the cumulative effect of about a 70 percent reduction in the incidence of attacked trees and 70 percent reduction in mortality of attacked trees.

Almost no beetle infestation occurred in treated areas for 16 months.

Control of the beetle by this method neither necessitates nor prohibits cutting of the attacked trees. Instead, control can be established and maintained at any time beetle activity is detected.

This procedure is especially adapted to the accepted principle that the time to apply control measures is before the insect has reached heavy epidemic proportions.

The method is most useful in active naval stores operations, where the important job of spotting attacked trees can be incorporated with the regular woods activities.

Southeastern Forest Expt. Sta., USDA, New Orleans, La.

Offord, H. R., Quick, Clarence R., and Moss, Virgil D. BLISTER RUST CONTROL AIDED BY THE USE OF CHEMICALS FOR KILLING RIBES. J. Forestry 56: 12-18. 1958.

Elimination of Ribes spp.³ in the vicinity of white pine by grubbing, by pulling, or by chemical treatment is the only means now known of controlling the destructive white pine blister rust (Cronartium ribicola Fischer).

Hand pulling and grubbing have been and are still the principal methods of killing ribes in white pine forests of the United States. Nevertheless, these methods are tedious and costly.

Successful chemical methods have been devised for killing ribes by 2, 4-D and 2, 4, 5-T applied as (1) aqueous sprays to the foliage and stems, (2) oil-extended sprays to the basal stems and root-crown, and (3) liquid or dry powder to the cut surface of plants decapitated at ground level.

Each ribes species has constituted a special problem in the development of the most economic toxicant and the method of application and equipment to be used. Knapsack and portable power sprayers have been adapted to work under forest conditions and have received special attention in developmental work.

2, 4-D and 2, 4, 5-T are advantageous herbicides in forest protection work because they are inexpensive, effective in small bulk or weight, non-inflammable, and non-poisonous to man, fish, and wildlife.

Calif. Forest and Range Expt. Sta. USDA, Berkeley, Calif.

Walker, Laurence C. BRUSH CONTROL IN THE GEORGIA PIEDMONT. J. Range Mangt. 12: 16-18. 1959.

The only consistency in the use of chemicals for brush control in the Piedmont of Georgia is inconsistency.

The rolling terrain north of the fall line in Georgia is characterized by criteria which, theoretically at least, may be responsible for erratic results from chemical applications. Since it is believed that plants must be physiologically active to absorb and translocate these chemicals, it follows that factors which inhibit active growth will serve

to decrease lethal chances. Probably the chief factor is the sporadic rainfall pattern resulting in an average of more than four two-week droughts per year over the past 65 years of record keeping.

Aspect, because of its influence on soil moisture, is particularly important in the growth of hardwoods. This has been pointed up by foresters in noting the encroachment and survival of deciduous trees on the more moist northern and eastern slopes, in contrast to their absence on drier south- and west-facing slopes. Aside from soil moisture, the low fertility and aeration levels of these soils are not conducive to plant growth.

The integrated factors of site--micro-climatic, physiographic, edaphic, and biotic--also lend their influence to the resistance or susceptibility of woody plants to brush control chemicals.

Other factors, such as size of trees, the time of day and the month of treatment, even within a particular season, may attribute to variance in results.

One major reason for apparent inconsistencies is the host of species which commercial formulations are expected to affect. At least 75 species of deciduous trees occur as brush in the lower Piedmont along with another 50 species of shrubs. All of these occur on abandoned lands which range men may wish to maintain in pasture. Naturally, metabolic rates and reaction to plant "hormones" will vary among them, resulting in wide differences in percentages of treated plants killed.

There has been an inverse relationship of response to treatment with dosage rate.

U. Ga., Athens, Ga.

Yocom, Herbert A. DEEP GIRDLES GIVE QUICKEST CROWN KILL OF OAKS.

J. Forestry 56: 217. 1958.

When it is important to kill hardwood crowns quickly, a girdle that goes all the way through the sapwood will probably be more effective than shallower girdles. Near Birmingham, Alabama, the crowns of some species of upland oaks died within a few days when the sapwood was completely severed during the spring. Of course, deep girdles take substantially longer to make than conventional ones.

Sprouting was not serious for any treatment. Most of the girdled trees put out one or more shoots, but these began to die almost as soon as they had formed. Only 15 percent of the treated trees had live sprouts by the end of the first growing season, and only 8 percent by the end of the second growing season. Most of the remaining sprouts are sickly and unlikely to need further attention.

South. Forest Expt. Sta., USDA, New Orleans, La.

Grano, Charles X. RESPONSE OF SOUTHERN RED OAK TO SEASONAL APPLICATIONS OF 2, 4, 5-T. J. Forestry 56: 140-141. 1958.

In south Arkansas, spring application of 2, 4, 5-T in frills on southern red oaks produced faster crown kill and quicker and more complete sprout control than application at any other season.

Summer applications caused red oak crowns to die just as rapidly as the spring applications did, but permitted more sprouting than treatments made at any other season.

Regardless of season of application, almost all tree crowns died within 2 years.

Sprout mortality after the first year was high for all treatments. The number of trees sprouting became negligible within two or three years.

South. Forest Expt. Sta., USDA, New Orleans, La.

Davis, James R. BASAL SPRAY WITH 2, 4, 5-T FOR WINTER HARDWOOD CONTROL IN EAST TEXAS. J. Forestry 56: 349. 1958.

Removal of competing hardwoods is essential to re-establishment of pine on many dry sites. Aerial spraying of silvicides or land-clearing with heavy machinery promises to be useful on extensive operations. For owners of small tracts, however, hand methods that can be applied at planting time are most acceptable.

Search for such a method at the Austin Experimental Forest in east Texas revealed that for December application, and presumably throughout the dormant season, 2,4,5-T is more effective when applied as a basal spray than when painted on cut stumps.

East Tex. Res. Center, Nacogdoches, Tex.

Davis, James R. DILUTED 2,4,5-T MORE LETHAL THAN UNDILUTED IN EAST TEXAS. J. Forestry 56: 516. 1958.

For inhibiting sprouts from freshly cut post oak and sweetgum in east Texas, 2,4,5-T was more effective when diluted with diesel oil than when undiluted, provided that the amount of acid equivalent in diluted and undiluted doses was equal. A double dose of undiluted chemical was nearly as good as the dilution, and might be practical where transportation of diluent is very expensive.

Results like these can be expected only when the chemical is applied during the growing season. Similar applications during December were ineffective, though the sprouts were somewhat delayed in appearing.

South. Forest Expt. Sta., New Orleans, La.

Stransky, John J. CONCENTRATED OR DILUTED 2,4,5-T AS A SUPPLEMENT TO GIRDLING? J. Forestry 57: 432-434. 1959.

This article reports on tests installed to determine whether full-strength 2,4,5-T concentrate, applied in a fine spray, would control sprouting and hasten crown kill of hardwoods girdled by ax or machine.

Post oak (Quercus stellata Wangenh.) and sweetgum (Liquidambar styraciflua L.) were chosen as test species because of their prevalence as weed trees on upland pine sites and because both sprout prolifically when girdled.

The study was conducted on upland pine-hardwood sites within the Stephen F. Austin Experimental Forest, near Nacogdoches, Texas. Soils are sandy loams overlying clay, and fairly representative of the better Upper Coastal Plain sites in east Texas.

Ax girdling was significantly better than power girdling only in topkill without chemical treatments. With chemicals there was no difference between ax and power girdling. Top-kill differences reflect promptness rather than eventual completeness of kill, since remaining tops are moribund.

All treatments involving 2,4,5-T resulted in significantly higher topkill than girdling alone. Concentrated and dilute 2,4,5-T killed crowns equally well; the concentrate, however, proved to be a poor sprout inhibitor, while the dilute solution was very effective.

There was no significant difference between the response of sweetgum and post oak.

Within the limited diameter range of the tests, size of tree did not affect results significantly.

Dilute 2,4,5-T was most effective in reducing sprouting when applied in early spring, least effective in the dormant season.

It is evident that the saving in material costs and transportation of dilutent envisaged in the design of this study cannot be fully achieved by application of undiluted 2,4,5-T. Where promptness of top kill is a primary consideration, application of full-strength 2,4,5-T in cambium girdles may prove useful. Where both prompt kill and inhibition of sprouts are required, the chemical should be applied in dilute form.

South. Forest Expt. Sta., USDA, Nacogdoches, Tex.

Tree Fruits and Nuts

Babb, M. F. TREE FRUITS FOR ALASKA. ALASKA Agr. Expt. Sta. B. 25., 12 pp. 1959.

This circular has been prepared with three major objectives in mind. (1) to define areas in which tree fruit culture is possible in Alaska and the types of fruit that can be grown in each, (2) to name and describe the varieties that at the present time seem more

desirable for planting in Alaska, and (3) to point out the main problems limiting tree fruit culture and suggest, rather than discuss, the probable means by which they may one day be solved.

Alaska Agr. Expt. Sta., Palmer, Alaska.

Vegetable Crops

Kern, Edward E. Jr. FARM MARKETING OF TRUCK CROPS IN BALDWIN COUNTY. Alabama Polytech. C. 130, 20 pp. 1959.

This study pertained to the farm marketing practices of 56 truck growers in Baldwin County. Only 11 per cent of the 498 individuals contacted in the County were engaged in commercial vegetable operations, including Irish potato and sweetpotato production.

This study revealed a general dissatisfaction among truck growers with regard to market outlets. About two-thirds of the respondents considered present outlets unsatisfactory from the point of view of dependability and competitiveness. Ninety-four per cent of the cucumber producers expressed dissatisfaction, but only 38 per cent of the Irish potato growers. The primary point of concern was the often inability to move commodities into marketing channels even at nominal prices.

The study revealed a diversity of crops marketed, in spite of the area being considered specialized in Irish potato production. In all, 12 different crops were found on sample farms and almost half of the respondents produced more than 1 crop for market. The average grower of Irish potatoes produced an average of 10 acres of truck crops.

Although local buyers predominated as outlets for cucumbers, Irish potatoes, and sweet corn, other types of outlets were also important, particularly farmers markets outside the County. Peddling and direct sales from the farm were also important among growers. A limiting factor in extending individual farm sales was the absence of farm truck transportation facilities. About 44 per cent of those in the sample had no trucks, and many who did had only trucks of the pickup type.

A wide variety of production practices prevailed among growers. This included fertilizer used, pest and disease control measures practiced, spacing, and varieties grown for market.

Most growers were white owner-operators with almost a lifetime of truck farm and total farm experience. The average age of owner-operators was 43 years, with only 9 per cent below 30. This would indicate that farm opportunities in the area have been able to attract and hold many growers but the low percentage of younger growers indicates that few new growers are entering the field.

The size of sample farms averaged 207 acres, considerably above that reported for the County. Growers generally did not consider credit as a limitation in the expansion of truck enterprises.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Kern, Edward E. Jr., FARM MARKETING OF TRUCK CROPS IN HOUSTON COUNTY. Ala. Polytech. C. 132, 20 pp. 1959.

Farm marketing characteristics and development opportunities found among the small vegetable producers in Houston County are likely to be similar to those in certain other parts of the State and Region. This is based on the fact that market structures are determined, in part, by production densities and the type of producer in an area. Houston County is composed mainly of small producers and vegetable production is rather widespread over the County. Vegetable farms averaged 91 acres in size with only about 7 percent of the land devoted to commercial vegetables and 56 percent to cotton, corn, and peanuts.

Of the 254 individuals contacted in this study, 71 were found to be engaged in commercial vegetable operations. The 28 percent were producing 14 different vegetables commercially. Forty-six percent of these produced only one vegetable for sale per farm. With the exception of watermelon acreage, all truck crops grown averaged less than 5

acres per farm. Field peas, watermelons, and tomatoes comprised about three-fourths of the total vegetable acreage on sample farms. Growers were not engaged in off-farm employment in contrast to other farmers in the County. Of the 183 respondents not engaged in commercial vegetable growing, rural nonfarmers predominated. Some were engaged in other farming activities and some had given up commercial vegetable production after failing to meet with economic success.

Most of the vegetable growers were white owner-operators with about 10 years of truck crop experience. Age of growers, together with longer farm experience, indicated that commercial vegetable production had been adopted in recent years as a means of supplementing cash income.

Growers financed operations primarily with their own funds, bank credit, and individual or dealer credit.

A major factor revealed in the study was the general dissatisfaction among growers regarding market outlets for crops produced.

Market news information was available to growers in the study only by personal contact. Growers viewed this as a definite limitation to market efficiency and possible development.

Growers in the past had been unable to maintain their own marketing facilities.

Outlets available to many growers were restricted by the lack of farm truck transportation.

There was wide variation in the use of commercial fertilizer and recommended pest and insect control measures by producers. Other production practices were uniform for the same commodities concerned.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Entomology Division, ARS, USDA. THE CORN EARWORM IN SWEET CORN - HOW TO CONTROL IT. U. S. Dept. Agr. L. 411. May 1957.

Uncontrolled, the corn earworm is the most destructive insect of corn in the United States. It causes millions of dollars worth of damage every year; it sometimes damages sweet corn so severely that the crop is unmarketable.

The corn earworm can be controlled most effectively with a DDT emulsion to which a light mineral oil is added.

For best results, spray sweet corn three times as follows: First, the day after the silks appear; second, 3 days later; third, 3 days later. Apply the insecticide to the silks; use enough of it to wet them thoroughly.

Directions for preparing 25 gallons of spray (sufficient for treating 1 acre of corn) and 1 gallon of spray (for a plot 17 by 100 feet) follow:

Mix 1 gallon 25-percent DDT emulsifiable concentrate and 1 gallon of light mineral oil with enough water to give you 25 gallons of the emulsion.

Mix 1/3 pint of 25-percent DDT emulsifiable concentrate and 1/3 pint of light mineral oil with enough water to give you 1 gallon of the emulsion.

Do not feed husks or other parts of corn plants treated with DDT to dairy or meat animals.

Inform. Div., ARS, USDA, Washington 25, D. C.

Darrow, G. M., McGrew, J. R., and Scott, D. H. REDUCING VIRUS AND NEMATODE DAMAGE TO STRAWBERRY PLANTS. U. S. Dept. Agr. L. 414, 8 pp., illus. June 1957.

Strawberry plants that are substantially free from disease-causing viruses are now available from nurseries the country over. In addition, the plants from many nurseries have undergone treatments that rid them of nematodes.

Growers who plant virus-free, nematode-free stock and keep it clean protect themselves from two common causes of serious strawberry losses. Virus diseases weaken plants, cut runner formation, and hold down berry yields. Nematodes, which are tiny eellike worms, feed on strawberry plant roots and seriously reduce their vigor.

The leaflet explains how virus and nematode-free plants have been developed and how to grow strawberries and keep them virus free and nematode free.

Inform. Div., ARS, USDA, Washington 25, D. C.

Pest control - General

Corley, T. E. USING LOW VOLUME FARM SPRAYERS. Ala. Polytech. Inst., C. 126. 1959.

Since World War II there has been increasing interest in farm use of liquid chemicals. This interest has centered around development of chemical weed killers, liquid insecticides, liquid fertilizers and liquid defoliants and desiccants.

Since high gallonage application of the chemicals in dilute form was sometimes ineffective and impractical, low volume sprayer were needed. Engineers working with entomologists developed low gallonage, low-pressure sprayers that give effective control of insects with applications as low as one gallon of spray per acre. In this publication, a sprayer that delivers 1 to 30 gallons of spray per acre at a pressure of 10 to 100 pounds per square inch (p. s. i.) is considered a low volume sprayer.

New chemicals and sprayers have been developed at a much faster rate than have their use on farms. The purpose of this publication is to explain proper sprayer use, how to calibrate the sprayer, how to mix chemicals, and special uses of spray equipment. The information presented is based mainly upon 10 years experience with sprayers in cotton mechanization research by the Experiment Station. In these studies sprayers were used for chemical weed control, insect control, and defoliation.

Agr. Expt. Sta. Ala. Polytech. Inst., Auburn, Ala.

Hayes, W. J. THE TOXICITY OF DIELDRIN TO MAN. World Health Organization. Bulletin. Palais des Nations. Geneve. 20(5): 891-912. 1959.

Increased use of dieldrin for malaria control has been caused by several factors, including sporadic resistance of some vectors to DDT. Poisoning of spray-men by dieldrin has been recognized in five widely separated countries and reported informally from several others. In some cases illness has recurred months after the last exposure. Observations of antimalaria programmes in Kenya, Tanganyika, Indonesia, India (Bombay State), and Iran and a review of the relevant literature have shown that the hazard associated with dieldrin is proportional to the degree of workers' exposure as determined by concentration of spray, area of bare skin, duration and a review of toxicity by different routes incriminates skin contamination as the greatest hazard under practical conditions. It is considered that dieldrin should not be used without justification; if it is required, then certain individual and group protective measures listed in this paper may minimize, but not necessarily eliminate, the risk. The author enumerates certain features of the toxicology of dieldrin which require intensive research.

Communicable Disease Center. PHS. U. S. Dept. of Health, Education and Welfare. Savannah, Ga.

Wilcox, G. E., Hollis, J. P., Fielding, M. J., Newsom, L. D., and Russel, D. A. THE EFFECT OF NEMATODE CONTROL ON THE GROWTH AND NUTRITION OF CERTAIN AGRONOMIC CROPS. Agron. J. 51: 17-20. January 1959.

Investigations over a 4-year period, 1953-56, on fumigation for control of plant parasitic nematodes and its effect on crop production were conducted on Ruston sandy loams with high infestations of nematodes at the North Louisiana Hill Farm Experiment Station. Fumigation treatments included methyl bromide (in Dowfume MC-2), D-D mixture, ethylene dibromide (in Dowfume W-85), Nemagon, Fumizone, and allyl alcohol. All chemicals gave good control of parasitic nematodes.

A healthy, more-vigorous root system was developed by plants growing on soil in which parasitic nematodes were controlled. This larger root system supported a larger plant. The root system of plants from the nonfumigated plots were discolored and damaged severely by nematode attack.

The yields of corn, cotton, and sorghum were significantly increased by nematode control. Oat and clover yields were not appreciably affected. The chemical composition of the crop plants investigated was not affected by soil fumigation. The addition of a fertilizer nutrient to the soil increased its percent composition in the plant equally on fumigated and nonfumigated soil. No change in available soil nutrient levels, as determined by standard analytical procedures, was detected in soil samples collected at planting time from the fumigated and nonfumigated plots.

Purdue U., Lafayette, Ind.

Porter, B. A. THE EASTERN TENT CATERPILLAR. U. S. Dept. Agr. L. 161, 5 pp., illus. 1958.

The conspicuous, unsightly nests or tents of the eastern tent caterpillar (Malacosoma americana (F.)), sometimes called the apple-tree tent caterpillar, are often seen in springtime on roadside trees or in neglected orchards. The tent is composed of layers of silky web spun by a group of caterpillars, which use the nest as a sort of apartment house.

The species is found all over the United States east of the Rocky Mountains and in limited localities in California, but is most prevalent in the Northeastern States. In the Rocky Mountains and farther west very similar species are found. The eastern tent caterpillar is native to this country, and there are records of outbreaks as far back as 1646. Sometimes the caterpillars become extremely abundant and troublesome for several years in succession, afterwards subsiding again to small numbers.

Wild cherry trees are the favorite hosts and are probably the starting points for many outbreaks. The apple seems to come next in favor, and is often attacked. Plum, peach, pear, rose, hawthorn, and various shade and forest trees are occasionally infested.

The nests and caterpillars are disfiguring to roadside, orchard, or yard trees. When the caterpillars become abundant they often eat all the leaves on a tree, which weakens it considerably, although it seldom kills it outright.

This Farmers' Bulletin explains the life history and habits of the eastern tent caterpillar, and how they can be controlled through spraying and other methods.

Inform. Div., ARS, USDA, Washington 25, D. C.

FORESTRY, WOODLOTS, AND SHELTERBELTS

Duffield, John W., and Snyder, E. Bayne. BENEFITS FROM HYBRIDIZING AMERICAN FOREST TREE SPECIES. J. Forestry 56: 809-815. 1958.

This article reviews some of the literature on hybridization of American tree species and comes to the conclusion that the benefits to American Forestry, which can at present be credited to hybridization, are few and not too impressive.

We have positive and increasing evidence that hybridization can, on occasion, increase both the adaptability and the pest-resistance of forest trees. There can be no doubt that it has an important place, together with other methods of tree improvement, in coping with these two problems.

Forty-three references cited.

South. Inst. of Forestry Genetics, USDA, Gulfport, Miss.

Wright, Jonathan W., Bingham, R. T., and Dorman, K. W. GENETIC VARIATION WITHIN GEOGRAPHIC ECOTYPES OF FOREST TREES AND ITS ROLE IN TREE IMPROVEMENT. *J. Forestry.* 56: 803-808. 1958.

In the past decade there has been a tremendous upsurge in interest in forest genetics. Some of this interest has centered around species hybridization, some around species introduction, some around provenance testing, and some around polyploidy. But the really big topic has been individual tree variation and its utilization in establishing seed orchards. This paper is a critical review of the philosophy behind this work and the results to date.

The most reliable data on individual-tree variation are from Scandinavian experiments on Scotch pine and Norway spruce and from western American experiments on western white pine. In all three species the indicated amount of genetic variation is great--large enough to permit us to make optimistic estimates of rate of progress following intensive selection and breeding programs.

Thirty-five references cited.

Mich. State U., E. Lansing, Mich.

Babb, M. F. PROPAGATION OF WOODY PLANTS BY SEED. *Alaska B.* 26. 12 pp. 1959.

This publication shows by table what treatment (if any) is needed to propagate seed of various trees and shrubs that can be grown in Alaska.

The various treatments, Stratification, Pretreatments by hot water, and Sulphuric acid, and Mechanical scarification are discussed.

Vegetative Propagation methods are listed for the different species.

Alaska Agr. Expt. Sta., Palmer, Alaska.

Zobel, Bruce J., Barber, John., Brown, Claud L., and Perry, Thomas O. SEED ORCHARDS--THEIR CONCEPT AND MANAGEMENT. *J. Forestry* 56: 815-825. 1958.

This article attempts to bring together the most pertinent information on American seed orchards, their objectives, establishment, and care.

A seed orchard is a plantation of genetically superior trees, isolated to reduce pollination from genetically inferior outside sources, and intensively managed to produce frequent, abundant, easily harvested seed crops. It is established by setting out clones (as grafts or cuttings) or seedling progeny of trees selected for desired characteristics.

Care must be taken to distinguish seed orchards from seed production areas, which are good natural or planted stands from which the phenotypically inferior trees are removed and which are specially managed to increase seed production. As such stands are not originally established for production of genetically improved seed, the selection of the trees they contain is much less intensive than in the case of seed orchards, and their genetic worth is therefore usually problematical.

Seed orchards require special treatment and care and some specialized equipment. Intensive cultural methods will be necessary to insure continuous production of the highest quality seeds. The high value of crops from seed orchards will justify intensive cultural practices, but many persons feel that, with the development of special harvesting equipment, improved seed will be produced in seed orchards more economically than unimproved seed is now obtained by ordinary methods of collection.

One-hundred and four references cited.

N. C. State Col., Raleigh, N. C.

Nienstaedt, Hans., Cech, Franklin C.; Mergen, Francois., Wu, Chi., and Zak, Bratislav. VEGETATIVE PROPAGATION IN FOREST GENETICS RESEARCH AND PRACTICE. *J. Forestry* 56: 826-839. 1958.

This article deals with the factors affecting the success of vegetative propagation of forest plants and to the details of the methods that seem to offer most promise with important American species. One hundred eighty-one references are cited.

The authors conclude that although much progress has been made in the vegetative propagation of forest trees, our knowledge is still insufficient to fully utilize these techniques. Grafting alone has found wide usage and is the principal method employed today. Rooting and air-layering, however, are infrequently used, and with few species. Air-layering usually gives better results than rooting but even this method is inadequate.

Lake States Forest Expt. Sta., USDA, Rhinelander, Wis.

Babb, M. F. ORNAMENTAL TREES & SHRUBS FOR ALASKA. *U. Alaska B.* 24, 39 pp., illus. 1959.

This bulletin summarizes findings from a nine year study of woody ornamentals in Alaska. Those familiar with such materials recognize that such a brief period of experimentation yields no hard and fast conclusions, even though supplemented by critical observation, and by the experience of those who have the advantage of a longer residence here.

Two classes of woody plants are described--those native to Alaska, and those introduced. Evaluation of these two classes of materials is necessarily different and has a different basis. It is known that native materials are hardy, and thanks to the work of the U. S. Forest Service, their range of adaptation is known. Their value as ornamentals is problematical.

The second class of materials consists of exotic trees and shrubs. Their ornamental value has been well established, but their range of adaptation in Alaska is for the most part still uncertain.

An attempt has been made to establish the range of adaptation of these introduced materials and the value of the native materials as ornamentals by distributing them for testing to cooperators from Homer to Fairbanks, to Venetie within the Arctic Circle, and to Chignik out on the Alaska Peninsula.

Alaska Agr. Expt. Sta., Palmer, Alaska.

Brender, E. V., and Davis, Lawrence S. INFLUENCE OF TOPOGRAPHY ON THE FUTURE COMPOSITION OF LOWER PIEDMONT FORESTS. *J. Forestry* 57: 33-34. 1959.

Invasion of pine stands by hardwoods presents a serious forest management problem in the lower Piedmont region of South Carolina, Georgia, and Alabama. Much of the land, originally covered by oak-hickory forests, seeded in to pure pine after being cleared for cultivation and then abandoned. On many sites hardwoods seed in again soon after the pine stands reach sapling size, but on other sites hardwoods are slow to encroach.

Observations made on the Hitchiti Experimental Forest near Macon, Georgia show that the rate of hardwood invasion is strongly influenced by aspect, degree of slope, and position on the slope. These factors outweigh and obscure any effect of soil type. A dense pine overstory retards the growth of a hardwood understory, but has little effect on the occurrence of hardwoods. These observations were substantiated by a detailed examination of understory types on 280 acres of 40- to 100-year-old stands of loblolly pine saw-timber on the Experimental Forest.

The authors make the following conclusions:

1. Loblolly pine can usually be perpetuated without hardwood control on all gentle upper slopes and on moderate upper slopes with a southwestern exposure.

2. Loblolly pine can be perpetuated if hardwood control measures are practiced on steep upper slopes with a southwestern exposure, moderate upper slopes with a north-eastern exposure, and on all moderate lower slopes.

3. Loblolly pine will be difficult, and perhaps unprofitable to perpetuate because of hardwood competition on steep upper slopes with a northeastern exposure, on all steep lower slopes, and in bottoms.

Southeastern Forest Expt. Sta., USDA, Asheville, N. C.

Avery, Gene. PHOTOGRAPHING FORESTS FROM HELICOPTERS. J. Forestry 57: 339-342. 1959.

Helicopters offer distinct advantages over fixed-wing aircraft for certain types of aerial photography. Reliable photo-mensurational data may be obtained either from large-scale single prints or from stereopairs. This report discusses practical aspects of taking helicopter photographs and summarizes two experiments involving their use in forest inventory.

Helicopters are well adapted to taking large-scale, low-altitude aerial photographs of forest areas. To offset flying costs, however, such photographs must be expected to yield information not obtainable from conventional 1:15,840 or 1:20,000 prints. Even under ideal conditions, costs are likely to limit the use of helicopters to photography of relatively small or high-value stands.

Forest Serv., USDA., Washington 25, D. C.

Institute of Forest Products. SIXTH BIENNIAL REPORT OF THE FOREST PRODUCTS COMMISSION. 1956-1958. 16 pp. 1958.

The dominant natural resource in Washington State is--its forest-growing lands. Of the 43 million acres of land which are included within the State's boundaries, almost 24 million, or 56 per cent of the total, are classified as land on which timber is growing in commercial quantities, or on which timber is the natural crop.

Approximately one-third of the State's industrial payroll results from utilization of its forests. In recent years this forest payroll has averaged about 285 million dollars annually.

Scientific management and protection of the growing forests within Washington State is the responsibility of professional foresters employed by the U. S. Forest Service, the State of Washington, and private owners of forest land. The State's own timber is very competently managed and protected by the Department of Natural Resources.

The Institute's responsibility starts where the forest managers' function ends; namely when timber is harvested. The Institute's job is to secure the maximum utilization of every unit of wood produced in these forests, and to find useful outlets for by-products and for "left-overs."

The Forest Products Commission, which was established to control Institute activities, chooses research projects of an extremely practical type which can become of immediate value to the State's forest products industry.

Among those work projects which have been accomplished by the Institute staff during the biennial period of July 1, 1956 to June 30, 1958, are the following:

1. Processing of sawdust and bark to produce soil compost.
2. Forest industry survey of Whatcom and Skagit counties.
3. Investigation of the wood supply and production of the pulp industry in the state of Washington.
4. New conversion factors for Pacific Northwest forest products.

A list of publications of the Institute are given.

Inst. of Forest Prod., U. Wash., Seattle 5, Wash.

Kalmer, L. F. THE ECONOMY OF INTENSIVE MANAGEMENT OF FOREST LANDS AS IT APPLIES TO SITE PREPARATION AND LAND REGENERATION. J. Forestry 56: 489-491. 1958.

The matter of site preparation, though relatively new, has caught on fast in our southern states during the last few years. As a matter of fact, there can hardly be any doubt in a southern forester's mind that the outstanding single management treatment being applied to forest ownerships in this region is site preparation. As we all know, southern industry, particularly the pulp and paper industry, is spending many thousands of dollars in preparing nonproductive or partially productive areas for plantation establishment or natural regeneration.

The majority of site preparation work is accomplished by employing the various makes of tractor equipment with accompanying attachments such as two-section harrows, choppers, chains, rakes, and an assortment of cutting blades. Becoming increasingly popular is the serial application of 2, 4, 5-T on areas that present a hardwood problem and those which are topographically unsuited to the operation of mechanical equipment.

It logically appears that the limiting factor in site preparation is the site quality of the land to be treated. It is fortunate that better sites bring higher returns because they are usually more expensive to prepare as they normally support more growing stock, desirable and otherwise. This means then that site quality classification is necessary in gauging the degree of site preparation than can feasibly be applied to any given area.

Continental Can Co., Savannah, Ga.

Kozlowski, Theodore T. WATER RELATIONS AND GROWTH OF TREES. J. Forestry 56: 498-502. 1958.

During the last several years droughts in New England have been responsible for much reduced growth of trees, poor fruit development, early leaf fall, dieback, thin foliage, transplanting failures, sunscorch, and death of trees.

Reduced growth of trees, early leaf fall, dieback, transplanting failures, sunscorch, and death of trees often occur as a result of an unfavorable internal water balance in trees.

Diurnal and seasonal variations in water contents of leaves and stems result primarily because water absorption lags behind transpiration. The absorption lag occurs primarily because of resistance to water movement across root cells.

Under prolonged drought leaves do not recover turgidity and become desiccated and scorched in summer. Winter injury also occurs widely when evergreens lose moisture and absorption cannot replace water in the leaves rapidly enough.

Growth of trees is checked by moisture deficits. Diameter growth appears to be more sensitive than height growth to variations in soil moisture supply during the growing season.

Water deficits in leaves check growth on trees by influencing carbohydrate supplies through direct and indirect effects on photosynthesis.

U. Mass., Amherst, Mass.

Stokes, C. M. and Yeager, J. H. COST OF CLEARING LAND. Ala. Polytech. C. 133, 22 pp., illus. 1959.

Improvements in methods and machines used in clearing land are important to farmers, land owners, land improvement contractors, custom operators, and others. Clearing time, costs, and conditions on a 24-acre, wooded site in northeastern Alabama were studied in this experiment. Two types of blades were used on three sizes of diesel crawler-type tractors.

Felling trees and brush and disposal of the material required significantly less time and cost less with a KG blade than with a dozer blade on any one of the three tractors, D-6, D-7, or D-8.

Trees were sheared off even with the ground by the KG blade. Large trees were dug with the bulldozer blade. Tree roots held large amounts of soil. Hence more soil was pushed into the windrow with the dozer blade than with the KG blade.

To reduce disposal costs, the windrowed trees and brush may be left to decay. The areas between windrows can be utilized.

Stumps left in the ground as the result of shearing off the trees with the KG blade may or may not be a problem in using the cleared land. If the land is seeded to pasture or pines, the stumps are a minor problem. If the field is disked or plowed with a heavy harrow, many roots and small stumps are cut into pieces.

There was a time advantage associated with the size of tractor in felling trees with both the dozer and the KG blade. There was little difference in time required in piling by the three sizes of tractors.

There was insignificant interaction between type of blade and size of tractor--that is the effect of size of tractor on time required and on costs was the same with both the dozer and the KG blade. Costs of clearing per acre were approximately the same for large, medium, and small-size tractors used in the test with the same type blade.

Variation in number of trees above 8 inches d.b.h. was more closely associated with time required in clearing than was the total number of trees. Plots with the greatest number of trees generally had a high percentage of pine trees. Small pines were sheared off without difficulty or loss of time with both the dozer and the KG blade.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

LeBarron, Russell K., WHAT IS UNIT AREA CONTROL? J. Forestry 56: 662-664. 1958.

Unit area control is a method of forest management that was developed in California. It was devised primarily because earlier methods of harvesting timber in pine and mixed-conifer types had not resulted in satisfactory regeneration and other desired objectives. The major distinguishing feature is adoption of unit areas composed of homogeneous condition classes as the subject of cultural treatments. Classification of a forest into unit areas also is useful for inventory, calculation of growth and allowable cut, and planning for a uniform distribution of age classes up to rotation age. It provides a system by specifying that management should be governed by the objectives of the owner, the silvical requirements of the trees, and the condition of the forest. In California, the indications are that it leads to even-aged management in small unit areas of about 5 acres although even-aged management is not an inherent requirement of the system.

Calif. Forest and Range Expt. Sta., USDA, Berkeley, Calif.

Curtis, Robert O., and Rushmore, F. M. SOME EFFECTS OF STAND DENSITY AND DEER BROWSING ON REPRODUCTION IN AN ADIRONDACK HARDWOOD STAND. J. Forestry 56: 116-121. 1958.

Observations on the development and reproduction of Adirondack northern hardwoods were made over a 17-year period on four 2 1/2-acre plots cut under different specifications. The treatments were clear-cut, light selection, shelterwood, and control. The principal results were:

A complete clear-cutting failed to give satisfactory regeneration of the better hardwoods.

On the selection plot, first and second cuts at 10-year intervals, each reducing the basal area to approximately 70 square feet per acre, resulted in increased numbers and size of understory beech, without any appreciable increase in hard maple and yellow birch reproduction.

On the shelterwood plot a first cut, reducing the basal area to approximately 50 square feet per acre, resulted in excellent reproduction of hard maple, yellow birch, and white ash.

Deer have had a marked effect on the amount and composition of reproduction.

Mowing of advance reproduction had only minor effects on regeneration of hardwoods.

The presence of abundant and aggressive beech in the understory appears to be a major problem in the management of this and similar stands. It is suggested that a moderately heavy initial cut may be necessary to obtain a desirable proportion of hard maple and yellow birch in the reproduction.

Adirondack Res. C., Paul Smiths, N. Y.

Skilling, Darroll D. RESPONSE OF YELLOW BIRCH TO ARTIFICIAL PRUNING. J. Forestry 57: 429-432, 1959.

The increasing value of high-quality northern hardwoods, especially yellow birch, has directed the attention of some foresters toward hardwood pruning as a means of improving timber quality.

The results of this study indicate that yellow birch will respond favorably to artificial pruning. Artificial pruning to 50 percent of total height had no effect on diameter or height growth. Pruning did increase clear bole length, and this effect was still present 10 years later.

Wound healing rate was related closely to both wound size and tree growth rate. Small wounds (under 2.0 inches) on rapidly growing trees healed in the shortest time.

The few epicormic branches which developed following pruning were short-lived. Three years after pruning, no live epicormic branches were present on any of the pruned trees.

Lumber defects such as ingrown bark, loose knots, and long, unsound branch stubs, were found in a high proportion of natural pruning wounds. Artificial pruning wounds developed none of these defects under good pruning practices. However, where large branches were not pruned flush with the bark, ingrown bark developed during healing. This indicated the importance of careful flush pruning. In no case was there any evidence that artificial pruning encouraged the development of decay.

North. Lakes Forest Res. C., Wausau, Wis.

Skilling, Darroll D. WOUND HEALING AND DEFECTS FOLLOWING NORTHERN HARDWOOD PRUNING. J. Forestry 56: 19-22. 1958.

The results of this investigation indicate that artificial pruning in young northern hardwood stands has possible practical applications. The importance of species and branch size on wound healing rates was not evident as long as the branch scars were under 2 inches. Healing rates of wounds larger than 2 inches would probably be influenced to some extent by wound size.

The necessity of pruning branches close to the bole was brought out emphatically during this study. Retention of even a 1/4-inch branch stub resulted in a delay in wound healing of 1 to 3 years.

Lumber defects such as decay pockets, overgrown bark, and long unsound branch stubs were found in a high percentage of natural pruning wounds. Artificially pruned branches, however, developed none of these defects following pruning. In all cases the wounds had healed over, producing sound, tight knots, free of heart rot. In no instance was there any indication that artificial pruning encouraged the development of decay.

On the study area, epicormic branching was not serious as long as pruning was confined to dominant and codominant trees. In many cases, however, the effect of pruning trees in the lower crown classes has been nullified by subsequent branching.

Lake States Forest Expt. Sta., St. Paul, Minn.

Gysel, L. W. ACORN PRODUCTION ON GOOD, MEDIUM, AND POOR OAK SITES IN SOUTHERN MICHIGAN. J. Forestry 55: 570-574. 1957.

From a comparison of estimates of maximum yield of acorns according to seed trap counts on sites classed as good, medium, and poor for the growth of oak in southern Michigan, the following conclusions were made:

1. The number of black oak acorns on medium and poor sites was approximately double that of red oak on good sites. The number of white oak acorns on good and medium sites was relatively small and approximately the same on both sites.

2. On a weight basis the red oak in the good site was approximately one-third more productive than black oak on medium and poor sites. The weight of white oak acorns, which was approximately the same on good and medium sites, was about one-sixth the weight of red oak.

Mich. State U., East Lansing, Mich.

Woods, Frank W. SOME EFFECTS OF SITE PREPARATION ON SOIL MOISTURE IN SANDHILLS OF WEST FLORIDA. *Soil Sci.* 85: 148-155. 1958.

In Lakeland sands of the study area, the 3- to 9-inch soil depth was found more useful in relating soil moisture to pine seedling survival than any other depth. The 0- to 3-inch depth is subject to high evaporation losses regardless of type of plant cover, and below 9 inches concentration of roots decreases sharply.

Soil moisture was found to be extremely important to survival of planted pines in Florida's sandhills: the greater the soil moisture, the better the survival. The only acceptable methods of site preparation for planting pines in deep sands, among those tested, are those which completely denude the site prior to planting.

South. Forest Expt. Sta., East Gulfcoast Res. C., Marianna, Fla.

Hansen, Norman J., and McComb, A. L. GROWTH OF PLANTED GREEN ASH, BLACK WALNUT, AND OTHER SPECIES IN RELATION TO OBSERVABLE SOIL-SITE CHARACTERISTICS IN SOUTHEASTERN IOWA. *J. Forestry* 473-480. 1958.

During the period 1938-1941, coniferous and broadleaf species were established by the Civilian Conservation Corps in plantations on old-field sites in the Weller-Lindley soil association area of southeastern Iowa. Most of the soils belong to the gray-brown podzolic great soil group. They are formed from loess and glacial till, are old, highly weathered, and usually have a fine-textured B-horizon (claypan) at 12 to 24 inches from the surface. On flatter upland ridges, terraces, and some bottomlands there are planosols which, because of relatively impervious claypans, are very poorly drained and aerated during periods of high rainfall. The surface layers of these soils are mostly loam or silt loam, and the B-horizons are clay loams or silty clays. The site index of oak commonly ranges from 45 to 55.

Growth and survival of plantation trees were studied in this area. With green ash, black walnut, and other species distributed over a variety of sites, an attempt was made to correlate growth with easily observable soil-site characteristics. The growth of the broadleaves is compared with that of pines planted on similar sites.

The principal results of this study are:

1. Pine species have been growing satisfactorily for 18 years and are beginning to produce merchantable wood products. In contrast, most broadleaf species could not be expected to produce merchantable material.

2. Height and diameter growth of ash were inversely correlated with the degree of erosion of the A-horizon.

3. On uneroded areas there was great variation in growth of ash. On these sites height growth was directly correlated with leaflet nitrogen, and high nitrogen and good growth were obtained on previously uncultivated soils.

4. An empirical method of predicting early height growth of green ash in the Weller-Lindley area, based on numerical ratings of seven site factors, was developed. The factors used were degree of erosion, depth to subsoil of low permeability, great soil group, color of surface soil, aspect, degree of exposure, and past land use.

5. The growth of black walnut was significantly correlated with (1) the texture and depth of the rooting zone, (2) presence of mottling and iron concretions indicative of internal drainage and aeration, and (3) color of the surface layers as indicative of the

content of organic matter and possibly the supply of plant nutrients. In all cases the correlation coefficients were low and it was not possible to predict walnut growth on the basis of easily observable site factors.

Iowa Agr. Expt. Sta., Ames, Iowa.

Minckler, Leon S., and Jensen, Chester E. REPRODUCTION OF UPLAND CENTRAL HARDWOODS AS AFFECTED BY CUTTING, TOPOGRAPHY, AND LITTER DEPTH. J. Forestry. 57: 424-428. 1959.

This study was made to investigate the development of reproduction after partial cutting in the Kaskaskia Experiment Forest in southern Illinois.

A survey of reproduction was made in 10 partially cut stands in central hardwoods upland types. On both moist and dry sites there was an average of more than 3,000 desirable, well-distributed seedlings per acre on the 10 areas surveyed. On the moist sites there were an additional 1,200 seedlings per acre of miscellaneous (undesirable) timber species. On the drier sites there were an additional 400 seedlings of miscellaneous and 1,300 seedlings of non-timber species. In general, competition from advanced reproduction of unwanted species was greatest on the moister sites; it is on these sites that cultural measures would be most effective.

Reproduction of the oaks and hickories was better on middle and upper slopes and on ridgetops. Reproduction of yellow-poplar was best on lower, northerly slopes.

In general, all species had more new reproduction on plots with the thinnest litter. The oaks, however, did just as well on plots with 1 inch of litter. Thicker litter caused only relatively slight reductions in oak reproduction. On drier sites, hickory reproduction was reduced only a small amount by thick litter.

Yellow-poplar was extremely sensitive to thick litter. This species definitely required cut openings, seed trees in the overstory, a seedbed with bare soil in thin litter, and absence of excessive brush. Yellow-poplar and the oaks had more new reproduction in the cut openings than under the canopy. All species grew faster in the openings.

Normally the species composition of the stands that develop from the present reproduction will be satisfactory, but some stands on the relatively moist sites will require special treatment. For optimum species composition, including a high percentage of yellow-poplar, specific cultural measures will often be required.

Central States Forest Expt. Sta., USDA, Columbus, Ohio.

Boyce, Stephen G., and Parry, Robert E. EFFECTS OF SEEDBED CONDITIONS ON YELLOW-POPLAR REGENERATION. J. Forestry 56: 751-753. 1958.

The rates of seed germination and seedling mortality of yellow-poplar associated with four different seedbeds ranging from undecomposed organic matter to bare surface of the soil B horizon were observed on a wooded area and in a field.

On the basis of evidence presented in this paper, the chances of obtaining natural regeneration of yellow-poplar are better in open areas than under dense canopies, and are better on the surface of the soil A horizon or on well-decomposed organic matter (the H layer) than on undecomposed organic matter or on the surface of the soil B horizon.

Central States Forest Expt. Sta., USDA, Columbus, Ohio.

Cooley, John H., and Lord, W. B. A STUDY OF ASPEN-BALSAM FIR CUTTING METHODS IN NORTHERN WISCONSIN--FIVE-YEAR RESULTS. J. Forestry 56: 731-736. 1958.

During the spring of 1950 a study, designed to evaluate various methods of cutting in aspen stands with balsam fir understories, was installed in northern Wisconsin. The stand selected had an overstory of aspen and paper birch averaged 36 years of age, and a

balsam fir, white spruce, and black spruce understory that varied from 15 to 35 years of age. The overstory, mostly aspen, made up approximately three-quarters of the total basal area prior to the initial cut.

Final evaluation of the study is not attempted in this report; however some results have been obtained which allow preliminary appraisal of the cutting methods studied.

Commercial clearcutting. --Commercial clearcutting increased the growth rate of the understory trees, although the stimulation was not as sharp as that of complete release.

Cutting from above. --Cutting from above was nearly as effective as commercial clearcutting in releasing the understory, yet it did not reduce the total production of merchantable volume as much as commercial clearcutting.

Cutting from below. --Cutting from below did not remove enough of the overstory to effectively release the balsam fir, and harvesting costs for the initial cut were much higher than for other cuts which removed only merchantable trees.

Complete clearcutting. --Complete removal of the overstory resulted in the greatest stimulus to the understory. However, when the extra cost of removing marginal and unmerchantable trees and the loss of growth on these trees are balanced against the additional understory growth, it is doubtful that this complete release is feasible.

Photographs of experiment.

Lake States Forest Expt. Sta., USDA, St. Paul, Minn.

Hough, A. F. ZONING FOR THE MANAGEMENT OF BLACK CHERRY ON THE ALLEGHENY PLATEAU. J. Forestry 57: 353-357. 1959.

A method of zoning forest land is proposed for use in the Allegheny Plateau region of northern Pennsylvania and southwestern New York. This method identifies areas favorable and less favorable for the perpetuation and management of repeated crops of black cherry. Elevations below which glaze damage to saplings and small poles is less serious are zoned as most desirable unless in the mixed oak, aspen-pin cherry, or hemlock forest types.

As an example of this method, 702,000 acres within the boundaries of the Allegheny National Forest have been zoned in detail. Of the total area, 59 percent was found to be in the zone most favorable for continued black cherry production and 41 percent in the less favorable zones.

Recommendations are given for the intensive management of black cherry. The questions of physiographic location, site, soils, methods of cutting, microclimate, stand condition, species composition, cultural practices, and protection are covered briefly.

Northeastern Forest Expt. Sta., USDA, Upper Darby, Pa.

Buchanan, W. D. THE SMALL OAK BARKBEETLE TRANSMITS THE OAK WILT DISEASE. J. Forestry 56: 414-415. 1958.

The results of oak wilt vector studies in Missouri provide additional evidence that the small oak barkbeetle (Pseudopityophthorus minutissimus (Zimm.)) may help spread oak wilt disease. This insect is being studied because (1) it breeds by the millions in the outer sapwood of small stems and branches of trees killed by oak wilt and in logging slash, and (2) it feeds in twig crotches, at the bases of leaf petioles, and on small stems at rough places on the bark and thus makes injuries that may serve as infection courts.

The successful transmission of the oak wilt disease in these studies is evidence that the small oak barkbeetle may help in spreading the disease. These studies, and field observations, indicate that the percent of beetles that transmit the disease is infinitesimally small. If this were not so, the incidence of oak wilt would be much greater than it is now.

Central States Forest Expt. Sta., Columbia, Mo.

Application of chemicals to living trees to extend the peeling season and to make easy peeling is rapidly becoming a new industrial tool for pulpwood operations. Although arsenic compounds have been used as commercial debarking agents, they have serious disadvantages: girdling is necessary requiring more labor and increasing the costs; they are toxic to human beings and wildlife; and the bark does not readily peel below the gridle.

Peeling resistance of aspen cut in the dormant season was significantly reduced by 2,4,5-T. Breasthigh spraying was more effective than spraying at the base. June treatments resulted in the least peeling resistance. Bolts from trees sprayed at breast height in June were satisfactorily hand peeled or debarked in a drum debarker even though cut in the dormant season when untreated trees can not be cleanly and economically peeled. Spraying with 2,4,5-T with concentrations of 16, 21, and 25 pound-acid-equivalent to 100 gallons of diesel oil showed similar results in debarking effectiveness. This may indicate that the range of concentrations studied is already beyond the least amount necessary to kill aspen.

Treatments with two forms of 2,4,5-T, Weedon-T, and ACP 329 gave satisfactory bark separation. On the other hand 2,4-D resulted in high-peeling resistance. Since girdling prevented these hormone chemicals from being absorbed and translocated, spraying without girdling is recommended. Treated aspen showed significantly higher moisture in both the bark and wood compared to untreated trees when they were both cut in August and September.

However, in untreated or check trees the moisture content of the wood increased rapidly at the end of the growing season. The chemical treatment retarded this rate of change. Therefore no significant difference in moisture content was found between untreated and treated trees when they were cut in October or the spring of the following year. Tyloses were abundant in the sapwood of treated aspen. This may retard chemical pulping. Debarking of aspen by this hormone chemical did not seriously damage the root system; and for this reason it is not likely to prevent aspen from establishing a second crop by suckering. This evidence indicates that chemically debarking aspen with butoxyl ethanol ester of 2,4,5-T gives promise as a practical and efficient industrial process.

Agr. Expt. Sta., Inst. of Agr., St. Paul. Minn.

Ahlgren, Clifford E. SOME EFFECTS OF FIRE ON FOREST REPRODUCTION IN NORTHEASTERN MINNESOTA. J. Forestry 57: 194-200. 1959.

The results of a six-year study of the effect of fire on the reproduction of various native tree species in northeastern Minnesota indicate that:

1. All species studied were capable of reproducing vigorously on burned-over land. However, the time of germination, optimum conditions for growth, and factors influencing reproduction varied among the species.

2. Fire not only aided in the dispersal of jack pine and black spruce seed, but also stimulated germination of jack pine.

3. By reducing the depth of the organic layer so that the seedling roots were able to reach mineral soil more quickly, fire improved seed bed conditions for jack pine and black spruce. These conditions also favored birch and aspen, especially on the more moist sites.

4. Poor reproduction was obtained where the fire did not reduce the organic matter and slash sufficiently.

5. The minerals present in the ash stimulated growth of a lush herbaceous cover. Usually, where not too dense, this provided shade and microclimatic condition favorable to young seedling growth.

6. There were some indications that the ash concentrations present on the soil surface inhibited the germination of black spruce. This inhibition, however, disappeared after one year.

7. Burning did not seriously reduce the concentration of mineral nutrients present in the soil, at least for five years after the fire.

Quetico-Superior Wilderness Res. C., Ely, Minn.

Morris, William G., and Mowat, Edwin L. SOME EFFECTS OF THINNING A PONDEROSA PINE THICKET WITH A PRESCRIBED FIRE. J. Forestry 56: 203-209. 1958.

Many stands of ponderosa pine saplings grow slowly because they contain a thousand or more surplus stems per acre. Since cost often precludes thinning by hand or machine in these stands, prescribed burning has been proposed as a possible thinning tool.

A dense stand of saplings on the Colville Indian Reservation in northeastern Washington was burned by a prescribed fire. This report describes only the effects on the stand during the first six growing seasons.

Effects on potential crop trees chosen after the fire were: (1) competitors were reduced from 2,410 to 895 per acre; (2) 46 percent of the crown was scorched; (3) 20 percent of the trees developed fire scars; (4) crown scorch and fire scars adversely affected height growth, but effect on diameter growth apparently was offset by a concurrent reduction in competition; (5) competition of other trees within 10 feet affected diameter growth but not height growth; (6) crop trees on the burn grew 36 percent more in diameter and 7 percent more in height than those on the unburned plots; (7) growth in both diameter and height showed a beneficial effect of burning in addition to thinning effect.

Pac. Northwest Forest and Range Expt. Sta., USDA, Portland, Oreg.

Weaver, Harold. ECOLOGICAL CHANGES IN THE PONDEROSA PINE FOREST OF THE WARM SPRINGS INDIAN RESERVATION IN OREGON. J. Forestry 57: 15-20. 1959.

Until the present century the ponderosa pine forest of the Warm Springs Indian Reservation in Oregon was typically open and parklike, with but little debris on the forest floor and with but scattered clumps of reproduction. That surface fires burned frequently is indicated by the tree-ring and firescar record and by accounts of early observers.

Since the early 1900's, as a result of overgrazing and fire exclusion, there have developed exceedingly dense understory stands of reproduction of various species over the entire area. Ponderosa pine reproduction characterizes lower elevations. Most of the area, however, is monopolized by reproduction of associated species and by various shrub species. Reproduction thickets are so dense that very poor growth is occurring. Also the thickets are adversely affecting growth and vigor of the overstory trees. Pine bark beetle epidemics have caused great damage and fire hazard has increased dangerously. Correction of these adverse developments poses very grave problems in silviculture, protection, and management.

Startling contrasts to these conditions are observed on a portion of the forest swept by a hot surface fire in 1938. This fire consumed many thousands of snags and windfalls of beetle killed pines. In most of the reproduction clumps sufficient dominant trees survived to still comprise an adequately stocked stand. These trees immediately accelerated in growth and are still growing at a rapid rate. Where thinning was too severe there has developed well spaced, vigorous subsequent reproduction of ponderosa pine. Overstory trees in general are vigorous and beetle resistant. Fire hazard is very low.

These contrasting conditions, inside of and outside of the burned area, confirm that fire is a continuing factor of great ecological importance. They also indicate that fire, under proper control, can be used as a silvicultural and hazard reduction tool.

Bur. of Ind. Affairs, Portland, Oreg.

Gaines, Edward M., Kallander, Harry R., and Wagner, Joe A. CONTROLLED BURNING IN SOUTHWESTERN PONDEROSA PINE: RESULTS FROM THE BLUE MOUNTAIN PLOTS, FORT APACHE INDIAN RESERVATION. *J. Forestry* 56: 323-327. 1958.

A small plot test of controlled burning in ponderosa pine near McNary, Arizona, on the Fort Apache Indian Reservation led to the following conclusions:

1. Fire, if properly controlled, may reduce fuels in ponderosa pine stands without excessive damage to trees larger than sapling size.

2. Fires hot enough to kill large living trees increase rather than decrease total fuel--ground plus standing.

3. Appreciable effective thinning was accomplished only on the burn of October 10, but this was more than offset by the area where the young stand was damaged or completely killed.

4. Few seedlings less than 3 or 4 feet tall survived on either burned area.

5. On the basis of plot averages for two years, which are not adequate for drawing final conclusions, grass density was reduced for only one year following the September 30 burn. Density still was reduced after two years on the October 10 burn where timber stands were damaged more severely.

6. Damage to timber stands was probably near the irreducible minimum on the September 30 burn, because of very favorable weather conditions.

Although this study indicates that controlled fire may be useful in reducing fuel in ponderosa pine in the Southwest, it points up the need for more information both on the conditions under which it is feasible, and on techniques for its proper use.

Rocky Mountain Forest and Range Expt. Sta., Flagstaff, Ariz.

Ferguson, E. R. RESPONSE OF PLANTED LOBLOLLY PINES TO REDUCTION OF COMPETITION. *J. Forestry* 56: 29-32. 1958.

The development of planted loblolly pine seedlings was studied during three growing seasons in east Texas. The seedlings were on plots where competing hardwoods or grasses has been controlled in various ways.

During dry seasons, first-year survival improved with increased intensity of release but during a year of well-distributed rainfall it was not much affected by release.

Survival after the first year was generally high, but losses in untreated and burned woods during 1956 reflected critical competition in a dry season.

Release from competition increased height growth for two or three years after planting--the increase was roughly proportional to the degree of release.

Seedlings on freshly prepared sites made better height growth than those on sites prepared a year before planting was done. The difference is believed to reflect renewed competition from invading vegetation that became rank on the treated areas during the second year.

Release benefited seedlings chiefly by lessening the competition for soil moisture; the effects were especially noticeable during droughts.

Under identical site conditions, trees planted in December grew taller than those planted in February.

South. Forest Expt. Sta., Nacogdoches, Tex.

Williston, H. L. SHORTLEAF VERSUS LOBLOLLY PINE IN NORTH MISSISSIPPI.

J. Forestry 56: 761-763. 1958.

In the early spring of 1936 the Southern Forest Experiment Station established twenty plantations, ten of loblolly and ten of shortleaf pine, on deep brown loam soils in Benton County, Mississippi.

The survival of shortleaf pine has been superior to that of loblolly. A sleet storm in 1947 damaged the loblolly far more seriously than the shortleaf.

At age 23 the tallest loblolly trees were 63 feet in height, the tallest shortleaf 48 feet.

Because of their greater diameter and height growth, the loblolly pines have produced 30 percent more merchantable wood to a 3-inch top diameter (inside bark) than the shortleaf pine. Loblolly grew 2.5 cords per acre per year, shortleaf 1.9 cords.

All plots were marked for thinning in 1957. The Cut averaged 22.6 cords per acre in the loblolly plantations, 19.2 cords per acre in the shortleaf. Since the wood sold for \$5.70 per cord, the gross annual return per acre now stands at \$5.64 for the loblolly plantations and \$4.76 for the shortleaf.

South. Forest Expt. Sta. USDA, New Orleans, La.

Boyer, William D. LONGLEAF PINE SEED DISPERSAL IN SOUTH ALABAMA. J. Forestry 56: 265-268. 1958.

A seed-trap study was established in South Alabama to determine how far, how many, and what direction longleaf pine seeds are dispersed into clearcut areas from nearby walls of timber.

A directional influence was apparent. The south wall dispersed the highest proportion (48 percent) of its sound seed into the clearing. The north, west, and east walls dispersed 38, 28, and 14 percent respectively of their sound seeds into the clearing. These differences are probably due to prevailing winds during seedfall.

Although these results are based on observation of a single year's longleaf pine seed crop in one particular stand, it seems likely that the trends indicated might be repeated even though different years and different stands would vary in total seedfall. Especially worthy of note is the observation that the zone of seedfall generally accepted as adequate for natural regeneration (15,000 sound seeds per acre) extended only 1 1/2 chains into clearcut openings even where more than 200,000 seeds per acre fell on the ground inside the stand bordering the clearcutting.

South. Forest Expt. Sta., New Orleans, La.

Boyer, William D. LONGLEAF PINE ESTABLISHMENT AND FIRST-YEAR SURVIVAL UNAFFECTED BY MODERATE GRAZING. J. Forestry 56: 655. 1958.

In a study in south Alabama, moderate grazing by cattle had little effect on the establishment and first-year survival of longleaf pine (Pinus palustris Mill.).

South Forest Expt. Sta., USDA, New Orleans, La.

Scheer, R. L. COMPARISON OF PINE SPECIES ON FLORIDA SANDHILLS. J. Forestry 57: 416-419. 1959.

A test comparing the suitability of five pine species for planting on the deep sands of west Florida was established in January 1954. Slash, loblolly, longleaf, and Monterey pines were planted both by hand and by machine on a site cleared of all vegetation by a rootrake-scalper. Shortleaf pine was hand planted only.

After four growing seasons, survivals of slash, loblolly, and shortleaf pines averaged 92, 93, and 88 percent, respectively. Only 32 percent of the longleaf pine still lived, and Monterey pine failed almost completely. Slash pine heights averaged 5.9 feet, as compared with 4.4 feet for loblolly pine and 3.5 feet for shortleaf pine. Only with longleaf did hand-planting produce better first-year survivals than machine planting.

Slash pine appears the most desirable of the five species tested for sandhills reforestation.

South. Forest Expt. Sta., USDA, New Orleans, La.

Minckler, Leon S., and Ryker, Russell A. COLOR, FORM, AND GROWTH VARIATIONS IN EASTERN REDCEDAR. J. Forestry 57: 347-349. 1959.

Certain characteristics of eastern redcedar (Juniperus virginiana L.) differ inherently according to location of seed source. Since such characteristics often determine the

use to which redcedar will be put--whether for posts, specialty lumber, or Christmas trees--it is important to know what these variations are and where to find seed that will produce the desired tree characteristics.

Eastern redcedar seed from eight widely separated sources was planted in one nursery bed and transplanted in replicated plots in southern Illinois. Six years after planting the trees exhibited wide genetic variations among the different sources. Color of winter foliage, crown form, and growth rate varied significantly among the progeny of the different seed sources. Other significant variations were survival, leaf form, and resistance to cedar-apple rust.

Color ranged from green through brown to purple. Crown form ranged from almost cylindrical to broadly conical. The range of average crown volume among sources was from 1.1 to 5.9 cubic feet. Average survival ranged from 16 to 97 percent. Leaf form varied from almost all appressed scale-like to half or more of sharp-pointed leaves.

Central States Forest Expt. Sta., USDA, Carbondale, Ill.

Williston, Hamlin L., and Huckenpahler, Bernard J. RESPONSE OF SIX CONIFERS IN NORTH MISSISSIPPI UNDERPLANTINGS. J. Forestry 56: 135-137. 1958.

In north Mississippi, fifth-year results of four consecutive years of underplanting ridge hardwoods with six conifers show that immediate release from hardwood competition greatly stimulates the height growth of seedlings. Seedlings on the released plots are almost three times as tall as those on unreleased plots. Release slightly improved the survival of loblolly, shortleaf, and longleaf pine.

Loblolly pine appears to be the best of six species tested for restocking depleted hardwood stands on dry loessial ridges. When released, it has survived as well as shortleaf and Virginia pines and nearly as well as eastern redcedar, and has substantially outgrown all three during the first five years.

On ridges of Ruston sandy loam, shortleaf pine has survived better than loblolly pine during drought years and may be preferable to loblolly on severely eroded areas where site protection is of paramount importance.

Virginia pine has also survived better than loblolly pine on droughty sites. Its dense foliage and low, spreading habit provide good site protection.

Slash and longleaf pines, because of their poor survival and known susceptibility to ice damage, are not recommended for planting in north Mississippi.

Redcedar has shown good survival on both Lexington silt loam and Ruston sandy loam soils but has been severely browsed by deer.

U. Miss., State College, Miss.

Boyd, Raymond J. CLEANING TO FAVOR WESTERN WHITE PINE--ITS EFFECTS UPON COMPOSITION, GROWTH, AND POTENTIAL VALUES. J. Forestry 57: 333-336. 1959.

The management of western white pine (*Pinus monticola*) requires the production of a high proportion of valuable white pine crop trees in order to defray the costs of protection from blister rust.

Results of two cleanings to favor western white pine show that: (1) compositional improvements have been maintained at a high level during the 20 years since cleaning; (2) improvement in size and volume of potential crop trees resulted from the reduction in stand densities; and (3) similar cleaning operations under current economic conditions should yield substantial economic benefits.

Intermountain Forest & Range Expt. Sta., USDA, Spokane, Wash.

Stage, A. R. GROWTH OF THINNED PONDEROSA PINE IN WESTERN MONTANA. J. Forestry 56: 757-760. 1958.

What can be expected from thinning dense young stands of ponderosa pine? Does thinning increase gross or net increment per acre, height growth, or diameter growth?

Does the response vary on different sites? The growth observed on three series of thinning plots established in 1933 and 1935 by the Northern Rocky Mountain Forest and Range Experiment Station indicates some of the answers to these questions for western Montana. Diameter, height, and cubic volume growth were improved by thinning, but the response varied by sites.

Intermountain Forest & Range Expt. Sta., USDA, Ogden, Utah.

Woods, Frank W. CONVERTING SCRUB OAK SANDHILLS TO PINE FORESTS IN FLORIDA. J. Forestry 57: 117-119. 1959.

West Florida's sandhills were once dominated by open stands on longleaf pine, usually averaging less than 4,000 board feet of merchantable timber per acre. For the past hundred years repeated cutting and indiscriminate woods burning have removed the pine and have prevented its re-establishment. As a result, the sandhills are almost completely occupied by worthless scrub oaks and wiregrass.

Intensive studies have failed to reveal a chemical that will kill both scrub oaks (chiefly Quercus laevis Walt. and Q. incana Bartr.) and wiregrass (Aristida Stricta Michx.) economically.

Fire kills the oaks, but the stumps sprout vigorously, resulting in an increased number of stems per acre. Wiregrass, which normally propagates vegetatively, produces flowers and seed after being burned and thus becomes more abundant than before.

Survival and growth of pine seedlings planted on west Florida sandhills are best on completely cleared sites, where available soil moisture is most abundant during critical dry periods.

On these sites a heavy doubledrum brush chopper eradicates oaks and wiregrass better than any other method.

Clearing operations should begin in late April or early May, with the repeat treatment coming not less than 6 weeks later.

Slash pines should be planted the first planting season following the clearing operation.

Sch. of Forestry, Duke U., Durham, N. C.

Ching, Te May. SOME EXPERIMENTS ON THE OPTIMUM GERMINATION CONDITIONS FOR WESTERN HEMLOCK (TSUGA HETEROPHYLLA SARG.) J. Forestry 56: 277-279 1958.

Studies were made on various lengths of pre-soaking time periods of stratification and temperatures of incubation to determine the optimum germination conditions for western hemlock (Tsuga heterophylla Sarg.). Nine northwestern seed lots were used for the 388 germination tests. The results indicate that no presoaking and no stratification are needed for germination test, and 20° C. incubation temperature gives the best germination results in the shortest time.

Agr. Expt. Sta., Corvallis, Oreg.

Silen, Roy R. ARTIFICIAL RIPENING OF DOUGLAS-FIR CONES. J. Forestry 56: 410-413. 1958.

Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) seed is seldom fully ripened on the tree before late August in the Pacific Northwest. Since natural seed fall may begin as early as the last week in that month, the cone collecting period is often short. Lengthening of this period is a worthwhile goal, for it would permit better organization of cone collection and allow skilled personnel to collect more of the crop. Artificial ripening of seed in cones picked in early August now appears to be a distinct possibility.

A study to determine whether or not Douglas-fir seed from cones picked early in the season could be artificially ripened was made on cones collected from five trees near the Wind River Nursery, Carson, Wash. Collections were begun on July 11 and continued at 10-day intervals until seedfall in early September. Of three storage methods tried, cones

stored at about 63° in damp peat moss gave full germination for collections made on August 1 and later. Storage in a running stream gave lower germination than other methods. Normal dry storage of cones in air gave no appreciable germination for collections prior to August 20 and even this collection yielded only about two-thirds of the germination obtained from the collection on August 30. Hence the damp-storage method is shown to be effective in ripening the immature cones and their seeds.

Seeds in the damp-stored lots, however, were more difficult to extract due to mold on the cones. Seedlings from damp-stored lots picked as early as August 1 were apparently normal but showed slightly less cotyledon and epicotyl growth. Dry-weight measurements of the seed kernels showed that damp storage of cones collected on August 1 resulted in seed only slightly under full weight.

The artificial ripening of seed in immature cones by some commercial method of damp storage appears possible for Douglas-fir. This may greatly lengthen the period of cone collection for this species, or provide a method of handling cones inadvertently picked before they are fully ripe.

Pacific Northwest Forest and Range Expt. Sta., USDA, Portland, Oreg.

Ferguson, E. R. AGE OF ROUGH (GROUND COVER) AFFECTS SHORTLEAF PINE ESTABLISHMENT AND SURVIVAL. *J. Forestry* 56: 422-423. 1958.

Successful establishment of natural pine reproduction depends to a large extent on the condition of the seedbed at the time of seedfall.

In the upland pine-hardwood type of east Texas, prescribed burns were made at four times of the year and at intervals of 3 to 43 months prior to the heavy shortleaf pine seed year of 1955. Measurements of seedling development indicated that:

With a better than average shortleaf seed crop, followed by a droughty winter, germination averaged only 3.7 percent.

Germination percent was reduced by about 1.4 percentage points for each year elapsing between burning and seedfall.

By early July, survival was similar, although fairly low, on all treatments.

At the end of an adverse season there were differences in survival that indicated the superiority of growing-season fires over dormant-season burns.

East Tex. Res. C., Nacogdoches, Tex.

Spurr, S. H. PLANTATION SUCCESS IN THE HARVARD FOREST AS RELATED TO PLANTING SITE AND CLEARING, 1907-1947. *J. Forestry* 54: 577-579. September 1956.

This paper is based upon an analysis of 125 cases of conifer plantings made between 1907 and 1937. They range in size from slightly less than one-half acre to 44 acres. They are subdivided according to whether the planting was done: (1) on open land of old fields or pastures, (2) on semi-open land of old fields or pastures, (3) after the cutting of pioneer hardwoods on old fields, (4) after the cutting of white pine or pine-hardwood mixtures, and (5) after the cutting of transition hardwoods.

All plantations on open and semi-open land have been successful. On cutover land planting site is most important. Few, if any, plantations on imperfectly drained land have survived hardwood competition. On excessively drained sites, only red pine, possibly Scotch pine, and European larch have proved capable of consistently taking over the area, with white pine and Norway spruce proving successful only under conditions of extreme drought and infertility. Red pine seems to be far the best plantation species in central New England, forming successful plantations with a minimum of cultural work on a wide variety of sites.

U. Mich., Ann Arbor, Mich.

Langdon, O. Gordon. CONE AND SEED SIZE OF SOUTH FLORIDA SLASH PINE AND THEIR EFFECTS ON SEEDLING SIZE AND SURVIVAL. J. Forestry 56: 122-127. 1958.

In the past, attempts to restock cutover lands by planting south Florida slash pine (Pinus elliottii var. densa) have often failed because of poor first year survival. Inferior nursery stock, improper handling and planting, and rigorous site conditions with alternate periods of high ground water and drought were some of the factors contributing to seedling mortality.

Grading seeds for size was effective in separating seedlings of significantly different survival capacities when field planted in South Florida. Large seeds from small cones resulted in the best survival. Large and medium-size seedlings survived slightly better than small ones.

Grading by seedling sizes separated slow and fast growers during the first year after field planting. Large seedlings from small cones grew best during this period. Seed size did not significantly affect total height at one year after planting.

Preliminary recommendations for South Florida slash pine based on results of this study are:

1. Collect the ordinary-sized cones in preference to the larger ones.
2. Grade seed by size to facilitate survival, nursery management, and seedling production.
3. Grade seedlings if seedling size will facilitate planting. It may help survival also.

Southeastern Fla. Expt. Sta., Asheville, N. C.

Lyle, E. S., and Gilmore, A. R. THE EFFECT OF ROUGH HANDLING OF LOBLOLLY PINE CONES ON SEED GERMINATION. J. Forestry 56: 595. 1958.

It is known that a relatively light impact on the seed can kill the embryo of some species of southern pine, but the effects of rough cone handling on seed germination are unknown. An investigation was undertaken at the Alabama Experiment Station to determine if any impacts that pine cones are likely to receive during collection and subsequent treatment would adversely affect germination of the seed contained in the cones.

Impacts were applied by swinging the unopened cones in partially filled burlap bags a minimum of 20 times against a concrete floor. These impacts were considered greater than any that cones would likely receive during ordinary collection and treatment. Cones used as the control were handled as gently as possible.

There was no apparent difference in percentage or rate of germination between the controls and the treated seed. However, there was a significant difference in the rate and percentage of germination between seed groups from different trees.

Although the experiment was not extensive, the authors are confident in the validity of the following conclusions. Presently recommended methods of handling loblolly pine cones are not harmful insofar as seed germination is concerned. Any impact short of crushing unopened loblolly pine cones will not affect the rate or percentage of germination of seed contained in the cones.

Agr. Expt. Sta., Auburn, Ala.

Hall, F. C., Hedrick, D. W., and Keniston, R. F. GRAZING AND DOUGLAS-FIR ESTABLISHMENT IN THE OREGON WHITE OAK TYPE. J. Forestry 57: 98-103. 1959.

In this study of farm forestry and grazing in the more productive oak woodlands of the Willamette Valley of Oregon, four questions were raised. These have been tentatively answered as follows:

1. Douglas-fir can be established under these stands with a considerable degree of success.
2. Sheep grazing, when carefully and properly managed, appears to be compatible with the establishment of Douglas-fir and under certain conditions favorably affects soil moisture.

3. The animal production per acre is influenced by the amount of crown cover of the oak, by the composition of forage species and by livestock management. Gains per acre by yearling sheep are sufficient to tentatively justify grazing these areas in the early stages of Douglas-fir forest regeneration if other suitable pastures are available to carry the principal grazing load.

4. Permanent pasture can be established with a minimum of seedbed preparation on sites similar to those described in this study, but unless maintained by adequate provision for sprout control, it will revert to a forested area within a period of ten years.

In addition, the study has pointed out that the absolute necessity of proper timing (season of use) and correct utilization of palatable plants (proper stocking) in avoiding damage to the establishment and growth of commercial Douglas-fir.

Oreg. State Col., Corvallis, Oreg.

Youngberg, C. T. THE UPTAKE OF NUTRIENTS BY WESTERN CONIFERS IN FOREST NURSERIES. J. Forestry 56: 337-340. 1958.

Samples of seedlings of eleven western coniferous species were collected from forest nurseries in California, Oregon, Washington, and British Columbia. Dry weight production, nutrient content, and nutrient removal were determined. For most species the nutrient removal from the soil was highest for nitrogen, intermediate for potassium, and lowest for phosphorus and calcium. Luxury consumption was indicated by the data from two nurseries. The uptake and content of nitrogen and calcium was lower than for eastern coniferous species and similar for phosphorus and potassium. Soil test data for the nurseries were also presented. In some instances, there appeared to be a good relationship between nutrient content and soil test data; in others, it was poor. This suggests a real need for additional basic research in tree nutrition and the relation of soil test data to nutrient uptake and responses by tree seedlings.

Oreg. Agr. Expt. Sta., Corvallis, Oreg.

Gilmore, A. R., and Livingston, Knox W. CULTIVATING AND FERTILIZING A SLASH PINE PLANTATION: EFFECTS ON VOLUME AND FUSIFORM RUST. J. Forestry 56: 481-483. 1958.

In an old-field plantation of slash pine, cultivation and light applications of NPK fertilizer during each of the first three growing seasons resulted in an apparent but not significant increase in pulpwood volume of about 10 percent after 19 growing seasons. There was a significant increase in number of trees with stem cankers of southern fusiform rust on cultivated and fertilized areas. Growing crops of cotton between the tree rows with additional, somewhat heavier fertilizer applications resulted in a further non-significant difference of about 21 percent was found between the volume of the control plots and the volume of the highest fertilized plots.

Whether nutrient elements added in fertilization were still present in the nutrient cycle of the stands was not clearly demonstrated. However, the amount of phosphorus found in both soil and litter was least on control plots and greatest on plots to which the most fertilizer had been added.

Agr. Expt. Sta., Ala. Polytech. Inst., Auburn, Ala.

Zahner, Robert. FERTILIZER TRIALS WITH LOBLOLLY PINE IN SOUTHERN ARKANSAS. J. Forestry 57: 812-816. 1959.

In the Spring of 1954 six fertilizer treatments were replicated nine times in 4 to 8 year old loblolly pine plantations in Southern Arkansas on Boswell sandy loam, Myatt fine sandy loam and Norfolk sandy loam. Average height and diameter growth of 20 trees in each replication were taken as the unit observations in analysis of variance. Chemical analysis of soil and foliage samples were taken. Height growth was not affected by any treatment but diameter growth was stimulated for two growing seasons by nitrogen fertilizer. Three-hundred pounds of N per acre gave better growth than 100 pounds the

second year, but not the first. The addition of phosphorous, potassium, or minor elements did not significantly increase growth over nitrogen alone. Foliar analysis showed that N, P, and K were picked up from fertilizers, the N in proportion to the quantity applied.

Sch. of Natural Resources, U. Mich., Ann Arbor, Mich.

Roth, Elmer R., and Evans, Thomas C. EFFECT OF SOIL AMENDMENTS ON GROWTH OF SHORTLEAF PINE. J. Forestry 56: 215-216. 1958.

In studying the nutritional aspects of the littleleaf disease of pine, researchers applied amendments to the soil surface of plots containing diseased and healthy shortleaf pine trees. The fertilizer was applied evenly over the entire surface of the plot and adjacent isolation strip. The plots were located on Madison, Louisa, and Hayesville soils on the General Pickens District of the South Carolina National Forests near Walhalla, South Carolina.

The trees fertilized in this study were, for the most part, small (12 inches d. b. h. and under). Even though some treatments resulted in increased growth, the trees did not put on enough additional board or cubic foot volume to result in important differences in volume.

The record shows that plots responding favorably received larger amounts of fertilizer added more frequently than the average owner could apply with profit. The present retail value of fertilizers applied to the plots that showed beneficial growth response is from \$18.00 to \$24.00 per acre per year.

These results show that fertilizing shortleaf pine on the soils and under the conditions described in these experiments is of doubtful value when measured in terms of growth response. In compact soils such as the ones fertilized in this study, some of the fertilizer is washed away and some is tied up before it reaches the roots.

Southeastern Forest Expt. Sta., USDA, Asheville, N. C.

Myers, Clifford A. THINNING IMPROVES DEVELOPMENT OF YOUNG STANDS OF PONDEROSA PINE IN THE BLACK HILLS. J. Forestry 56: 656-659. 1958.

Natural regenerations of ponderosa pine (*Pinus ponderosa* Laws.) is easily obtained in the Black Hills on all but the poorest sites. With a seed source nearby, burns and other deforested areas may restock with dense stands of seedlings. If left to develop through natural thinning, these stands become crowded sapling thickets.

In 1931 and 1933 a study was made to determine suitable spacings for thinning ponderosa pine in the Black Hills. Dense 28- and 40-year-old stands and a slightly overstocked 55-year-old stand were selected for study. Three plots thinned to different spacings and one unthinned plot were established in each stand. These plots were remeasured in 1956.

The 28- and 40-year-old stands responded favorably to precommercial thinning. Growth in diameter, height, basal area, and pulpwood volume was greater on thinned than on unthinned plots. Despite death of about half the trees on the unthinned plots, they are still too heavily stocked for satisfactory stand development.

Growth after thinning was about the same for all spacings tested in the 55-year-old stand. The heaviest thinning, however, concentrated wood growth on the best trees available.

Where sawlogs are to be produced with one precommercial thinning, the results suggest thinning to about 550 trees per acre when average d. b. h. is 1 inch, 425 trees when average d. b. h. is 2 to 3 inches, and 300 trees when average d. b. h. is 5 inches. The data are inadequate to determine the one best spacing for each stand diameter class.

Rocky Mountain Forest and Range Expt. Sta., USDA, Fort Collins, Colo.

Haworth, Frank G. RATE OF SPREAD AND INTENSIFICATION OF DWARFMIS-
TLETOE IN YOUNG LODGEPOLE PINE STANDS. J. Forestry 56: 404-407. 1958.

Studies were made in 33 burned over lodgepole pine stands in Colorado and Wyoming to determine how fast dwarfmistletoe can be expected to spread from residual stands to reproduction on clearcut areas. The results indicate that in about 20 years, dwarfmistletoe will have progressed less than 30 feet in the reproduction. In 30-year-old reproduction, the parasite will have spread 30 to 45 feet, depending primarily on the density of the young stand. Spread through young lodgepole pine is 1.5 times greater in stands in which the canopy has not closed than in stands with closed canopies. In 20-year-old stands, about 10 percent of the trees within 30 feet of an infective mature stand were infected. In 30-year-old stands, infection in this zone was about 35 percent.

Rocky Mountain Forest and Range Expt. Sta., USDA, Fort Collins, Colo.

Guilkey, Paul C., Rudolph, Victor J., and Sheppard, George. EFFECTS OF SWEET-FERN RUST ON THE GROWTH OF YOUNG JACK PINE IN NORTHERN LOWER MICHIGAN. J. Forestry 56: 900-902. 1958.

Measurements in a 15-year-old plantation of jack pine in Lower Michigan, originally established as a test of spacing and later transformed into a test of thinning, provided an opportunity to compare the growth of healthy and rust infected trees.

Height and diameter measurements showed no significant difference between the growth of healthy and rust infected trees. Survival counts in the fifteenth and sixteenth years showed no mortality caused by the blister rust. This plantation had been marked for thinning before the presence of the rust was discovered. Apparently the rust had no influence on the general appearance of the trees that would influence marking since no significant difference was found in the incidence of infection between the thinned and un-thinned plots.

An examination of a heavily infected jack pine plantation of the same age, located 10 miles from the spacing study, also disclosed no differences in diameter growth attributable to the rust.

Apparently the effect of the rust on radial growth of jack pine is largely limited to that part of the bole in the immediate area of the canker.

This study indicates that a sweetfern blister rust canker at the base of a jack pine tree does not affect the growth of the tree. However, the exposed dead wood of the cankers may serve as an entrance court for wood rotting fungi that will result in loss of wood and perhaps breakage as the bole is weakened.

Lower Peninsula Res. C., Lake States Forest Expt. Sta., USDA, East Lansing, Mich.

FARM ECONOMICS

General

Botts, R. R., and Boles, J. N. USE OF NORMAL-CURVE THEORY IN CROP INSURANCE RATEMAKING. J. Farm Econ. 40(3): 733-740. August 1958.

The Federal Crop Insurance Corporation has developed a method of computing losses that utilizes the normal-curve theory. It is used when county yields are available but when little is known as to the distribution of farm yields around their average, the county yield. This article has as its purpose (1) the derivation of the FCIC formula and the presentation of an example of its use, and (2) the derivation and application of a formula recently suggested for use in connection with a proposed experimental program on paddy (rice) in six districts of Ceylon. The latter involves an "area" plan of insurance.

ARS, USDA, U. Calif., Berkeley, Calif.

Stocker, F. D. RECENT TAX CHANGES AFFECTING FARMERS. U. S. Dept. Agr., Agr. Res. Serv., Farm Econ. Res. Div., Agr. Finance Review, Vol. 21, pp. 1-6. July 1959.

The several revisions the Congress made in its 1958 session are the first substantive changes made since the thorough overhaul to the tax law in 1954. These revisions are discussed.

FERD, ARS, USDA, Washington 25, D. C.

Scofield, W. H., and Stocker, F. D. TAX CONSIDERATIONS IN FARM REAL ESTATE TRANSFERS. U. S. Dept. Agr., Agr. Res. Serv., Farm Econ. Res. Div., Agr. Finance Review, Vol. 21, pp. 7-17. July 1959.

Tax considerations enter into the decision that each owner of real estate, whether farm or nonfarm, must make as he approaches retirement--whether and how to dispose of his property.

In broadest terms three alternatives are available: (1) Retain the property until death and allow it to pass to the heirs; (2) transfer property before death to the heirs by gift or sale or; (3) sell in the open market. Knowledge of the tax implications of these alternative decisions can help both present and prospective owners to accomplish their objectives with minimum tax obligations.

FERD, ARS, USDA, Washington 25, D. C.

Davis, J. F. USE OF ELECTRICITY ON FARMS. A SUMMARY REPORT OF TEN AREA STUDIES. U. S. Dept. Agr., Agr. Inform. B. 161. November 1956.

The 11 studies in the 10 major type-of-farming areas--East Tennessee Valley, Southwestern Kansas, Eastern Dairy Area of Wisconsin, Eastern Livestock Area of Iowa, New York and New England, Clay Hills Area of Mississippi, North-central North Dakota, Upper Piedmont of Georgia, Eastern Washington, Northwestern Washington--were intended to establish criteria that would be useful in estimating future consumption of electricity on farms of different types and in different situations, and to appraise some of the ways in which electricity and electrical equipment can be used to further the goals of farmers and their families. In these areas, average consumption of electricity per farm in the decades of study increased at geometric rates, which ranged from 7 percent a year in southwestern Kansas to 21 percent in eastern Washington. Many factors contributed to the increased use of electricity in these areas. Among these were technological developments of electrical equipment of various kinds; the time element involved in becoming aware of the equipment and the buying and installing by farmers of the kinds wanted; the generally rising farm income during the period of study; the increasing size of commercial farms; the rising standards of living; and the shortages of labor.

Inform, Div., ARS, USDA, Washington 25, D. C.

Hess, Carroll V. FARM BUDGETING REFERENCE MANUAL. A.E. Res. 15, 65 pp. 1959.

Farming today is a dynamic and complex business. The introduction of new farming techniques and changing prices forces farmers continually to reappraise their farming operations to keep them up-to-date. Adoption of even one new production practice may mean changing the cropping program, which in turn may require replanning the livestock system, the labor program and perhaps even altering the machinery and building needs.

An orderly and systematic approach to Farm Planning is represented by the farm budget, which is a written plan outlining the acres of crops, the numbers of livestock, estimated receipts and expenses for each of several alternative farming systems.

This manual has been developed in two parts. In Part I, the role of budgeting in developing and comparing farm plans is discussed. Specific attempts were made to:

1. Indicate the nature and uses of farm budgeting;
2. Describe budgeting as a planning tool of analysis;
3. Show the relation of budgeting to record keeping, farm analysis, and planning; and
4. Outline some computational rules and procedural steps in budgeting.

Part II presents the budgeting data used in an analysis of adjustment alternatives for dairy-cash crop farmers located on the deep, high-lime soils of the Central Plain Region in Western New York. Similar data need to be developed for other areas and continued study of production relationships is required to improve our knowledge of them and to keep abreast of influence of new technology.

Cornell U. Agr. Expt. Sta., Ithaca, N. Y.

Farm Economics Research Division, ARS. LAND OWNERSHIP IN THE GREAT PLAINS. A PRELIMINARY REPORT. U. S. Agr. Res. Serv. ARS 43-93, 31 pp., illus. June 1959.

In the 10 Great Plains States, 99 percent of the privately owned land is in some agricultural use. Corporations make up less than 1 percent of the owners and hold about 8 percent of the farm and ranch land and 2 percent of the total value of this land. A husband and wife combination is the most common type of owner. Either jointly or separately, they own 49 percent of the farm and ranch land. Partnerships other than husband and wife own another 20 percent. Nearly 30 percent of the owners are 65 or older, and less than half of all owners are active farmers or ranchers. Forty-five percent of the owners are not living on any of their farm or ranch land. Most of the owners bought their land but almost a fourth obtained it with the aid of gifts or inheritances. Landlords, who operate none of their land, make up a fourth of the owners and own a fifth of the land. In 1945, the average ownership unit contained 570 acres; in 1958, it contained 643 acres. The proportional distribution of land among owners changed little from 1945 to 1958.

The survey on which this report is based was made in the winter of 1957-58. It covered the States of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Montana, Wyoming, Colorado, and New Mexico.

Inform. Div., ARS, USDA, Washington 25, D. C.

Moore, E. H., and Barlowe, R. EFFECTS OF SUBURBANIZATION UPON RURAL LAND USE. Mich. Agr. Expt. Sta. Tech. B. 253. September 1955.

This bulletin reports a study of the effects of suburbanization on rural land use patterns, property values, and local attitudes toward community services in two segments of the suburban area surrounding the city of Lansing, Mich. Interviewed in the study were 224 families, 58.5 percent of whom were rural residents; 25 percent were full-time farmers; and 16.5 percent were part-time farmers. Of the rural residents, 62 percent held less than 3 acres of land, and 22 percent held more than 10 acres. Almost two-thirds of the full-time farmers had holdings of 100 acres or more. More than half of the part-time farmers held between 30 and 99 acres. Much of the area not used as building sites was rented out or used for gardens, pasture, or crops. Large percentages of the land held by rural residents were classified as idle. Combined with the idle land in farms, 31 percent of one segment and 8 percent of the other were idle at the time of the study.

Demand for housing and homesites is considerable. Farmhouses and building lots have increased in value with the influx of rural residents into the areas. There is no marked demand for new community services, but local school problems have been aggravated.

Mich. Agr. Expt. Sta., East Lansing, Mich.

The field study on which this report is based was made in an area in which many Atlantic Coast workers spend the winter. A sample of the migratory workers located there in March 1953 was interviewed in regard to employment and earnings in the previous 12 months. Most of these workers, all of whom were Negroes, came originally from other Southeastern States; more than half of them came from Georgia. Ordinarily, they did not enter the Atlantic coast migratory stream until 3 or 4 years after their arrival in Florida. The migrants were comparatively young--more than 50 percent were under 35; only 20 percent were over 44. Households of these workers were small, averaging only 2.8 persons. Heads of approximately a fourth of the households were women. The workers were predominantly rural. In the 5 years preceding the interview, only 5 percent had done any nonfarm work and only 4 percent gave nonfarm work as their major activity in the preceding year. The movement of these workers was uniform. Eighty-five percent left Florida in May or June, and their return movement was almost as uniform. Patterns of movement outside Florida were also comparatively regular; 45 percent worked in only 1 State outside Florida, most frequently New York. Workers in the sample obtained an average of 182 days of employment in the 12 months preceding interviews, 98 of which were in Florida and 84 out of the State. The average number of workdays on which no work was done during the last year was 71, although workers were available for work on 48 of these days. Earnings per worker for the year from farm and nonfarm work averaged \$908 and earnings per household \$1,733.

Inform. Div., ARS, USDA, Washington 25, D. C.

Miller, W. G., Chryst, W. E., and Ottoson, H. W. RELATIVE EFFICIENCIES OF FARM TENURE CLASSES IN INTRAFIRM RESOURCE ALLOCATION. Iowa Agr. and Home Econ. Expt. Sta. Res. B. 461, pp. 321-399. November 1958.

The data on which this analysis is based was obtained by personal interview at 3-month intervals during 1954 from a stratified random sample of 588 farmers in Iowa and the northern two-thirds of Illinois. Owner-operators and livestock-share and crop-share-cash renters were the tenure classes considered. Analysis of resource marginal returns showed that the kinds of resource adjustments needed to approach optimum production levels vary to some extent according to tenure class. The resource allocation of owner-operators could be improved with the use of more capital services, although part of the lower productivity of labor under owner-operatorship might be attributed to its quality. Under the two lease types studied, the patterns of marginal returns to resources are similar--all marginal returns are higher than the opportunity costs assumed. The most limited resource is land. Younger owners were found to be least efficient, showing the largest deviation of actual "costs" from the minimum costs attainable. Livestock-share renters are the most efficient. Differences between the tenure groups in their deviations from minimum costs could be due to chance. Hence the traditional broad classes of tenure examined may not differ in the aggregate with respect to the level of efficiency achieved in terms of resource combinations. The kinds of adjustments needed to approach an optimum combination of resources, however, vary between owners and tenants. The owner-operators studied should have used less of both land and labor and more capital.

Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Hendrix, W. E. APPROACHES TO INCOME IMPROVEMENT IN AGRICULTURE. U. S. Dept. Agr. Prod. Res. Rpt. 33. August 1959.

This study is directed toward an examination of the nature, causes, and possible solutions of the low-income farm problem generally. For this purpose, lessons derivable from the experiences of farmers receiving assistance under the Operating Loan Division of the Farmers Home Administration in the years 1947 through 1953 were used. The study

was made possible through the cooperation of the Farmers Home Administration in providing access to records on the operations of its borrowers. It is not designed, however, to provide an evaluation of the Farmers Home Administration program; it merely draws upon the operations of farmers assisted by the FHA program to evaluate a variety of ideas as to the nature and possible solutions of the low-income farm problem as it still exists on many of the Nation's farms.

Inform. Div., ARS, USDA, Washington 25, D. C.

Goodsell, W. D. COSTS AND RETURNS, COMMERCIAL FAMILY-OPERATED FARMS, BY TYPE AND SIZE, 1930-1951. U. S. Dept. Agr., Stat. B. 197, Wash., D. C. November 1956.

This report gives summary statistics on 27 important types and sizes of farms in 15 major farming areas in the United States. Twenty-three of the series represent average commercial family-operated farms of a particular type located within comparatively homogeneous farming areas. Four series pertain to "size-type" commercial family-operated farms. These are farms that are smaller or larger than average commercial family-operated farms and on the basis of size represent only part of the range of commercial family-operated farms.

These so-called "size-type" farms include the large-scale and small cotton farms in the Mississippi Delta area and the small tobacco and large tobacco-cotton farms in the Coastal Plains of North Carolina.

The series on some types of farms begin with 1930. Others begin with 1935, 1937, 1940, 1943, or 1944, depending on the time the study was undertaken, the accessibility of data, whether or not estimates for earlier years would be worth the extra cost, and whether or not at the beginning date farmers and ranchers were experiencing unusual weather or economic conditions. The series on irrigated cotton farms in the High Plains area of Texas goes back only to 1944, because irrigation was not important in this area before that date.

Inform. Div., ARS, USDA, Washington 25, D. C.

U. S. Dept. Agr., Agr. Res. Serv. FARM COSTS AND RETURNS. U. S. Dept. Agr., Agr. Inform. B. 176. June 1958.

This is the annual report on farm costs and returns on important types and sizes of commercial farms in major farming areas in the United States. It presents summary statistics for 1957 and comparisons with data for earlier years on 31 types of commercial farms in 18 important farming areas in the United States.

Inform. Div., ARS, USDA, Washington 25, D. C.

Christ, J. H. IMPROVING HAWAIIAN SOIL RESOURCES. U. S. Dept. Agr., Soil Conserv. Serv., Unnumb. Pub., 46 pp. July 1958.

Land is a precious commodity in Hawaii. The ancient Hawaiians and the present day mostly adventitious Hawaiians lived close to the soil. The taro patch was the primary source of food. Kamehameha III phrased the motto of Hawaii that continues to be expressive, "UA MAU KE EA O KA AINA I KA PONO,"--The life of the land is perpetuated in righteousness. Today's sugar and pineapples provide the balance of trade of an advantageous economy. Protecting the land from deterioration and developing it for greater production are not incompatible courses of action. Present day travellers between the islands of the Hawaiian chain obtain an expressive picture of the land. Nowhere is it seen so vividly as by the air route which constitutes almost the sole means of inter-island passenger transportation. The green fields, the windbreaks, the wooded mountain slopes, the deep lush tropical valleys, and rain forests all emphasize the intent to clothe the land with protective measures. Storms still take too large a toll of the good soil from unprotected fields and from poorly or unvegetated range and forest land.

There's much yet to do, but there is a firm, real desire in the many facets of Hawaii's population to see that the lands of this Island Paradise continue to deserve the title. It is gratifying to see the progress which has been made in the last half century. It is stimulating to note the determination of so many fine people to make Hawaii safe from land-destroying elements.

This publication contains numerous illustrations concerning Hawaiian agriculture.

Office of Inform. USDA, Washington 25, D. C.

Sutherland, J. G., Bishop, C. E., and Hannush, B. A. AN ECONOMIC ANALYSIS OF FARM AND NONFARM USES OF RESOURCES ON SMALL FARMS IN THE SOUTHERN PIEDMONT, NORTH CAROLINA. N. C. Agr. Expt. Sta. Tech. B. 138. May 1959.

The purpose of this study is to analyze the economic conditions families on small farms are likely to face in the future and to specify under which of the conditions it would be profitable for them to engage in (a) full-time farming, (b) part-time farming, and (c) full-time nonfarm employment.

This study shows that nonfarm employment is an effective means of supplementing farm family incomes. With substantial amounts of additional investment capital for the development of profitable farming systems, however, farm family incomes can be increased to levels approximating those obtained in industry. In the absence of nonfarm jobs, the expenditure of relatively large sums of additional investment capital is required on most small farms before incomes from farming can be substantially increased. As substantial risk is involved in investing large sums of money in farming, it is unlikely that most operators of small farms would expand farm operations to that point, particularly, if borrowed capital were involved. The safer course of action would be to organize the farm and family resources around some combination of both farm and nonfarm work involving a more moderate expenditure of additional investment capital in farming.

N. C. Agr. Expt. Sta., Raleigh, N. C.

Burch, T. A., and Butler, C. P. PHYSICAL AND ECONOMIC CHARACTERISTICS THAT LIMIT ADJUSTMENTS ON FULL-TIME MEDIUM-SIZED FARMS IN THE PIEDMONT AREA OF SOUTH CAROLINA. S. C. Agr. Expt. Sta. B. 453, 50 pp., illus. Mar. 1958.

Only 40 percent of the medium-sized farms in the Piedmont area are full-time farms, whose productivity as reflected by their organization and practices is relatively low. Relatively few produce incomes comparable to those received by industrial workers. Those that do show that a proper combination of resources and application of sound management practices provide incomes larger than those received by many nonfarm workers.

Conditions that contribute to low productivity and income are (1) Idle cropland overgrown with bushes and weeds; (2) land not used according to capability; (3) low rates of fertilization; (4) use of obsolete power and equipment; (5) use of seed of poor quality; (6) inadequate insect-control measures; (7) poorly balanced farming systems; and (8) inadequate capital and financial arrangements. Also, these farmers show a reluctance to seek and use the help available to them from State and Federal agencies.

It was found that the level of management of these low-income farmers was closely related to age and education. More than a third were over 65 and another 29 percent ranged in age from 55 to 64. Nine percent had had no formal education and 55 percent had completed less than the 8th grade. This educational background, together with the fact that the farming experience was almost exclusively that of growing cotton and corn under a sharecropper system and with mule power, imposes serious limitations to the introduction of new enterprises. There is need for assistance to these operators in the planning and supervision of adjustments in farming systems.

S. C. Agr. Expt. Sta., Clemson, S. C.

Lanham, W. J., and Butler, C. P. ECONOMIC ANALYSIS OF ANNUAL ADJUSTMENTS IN DEVELOPING A BEEF CATTLE-GRAIN FARM IN THE PIEDMONT AREA OF SOUTH CAROLINA. S. C. Agr. Expt. Sta. B. 459, 43 pp., illus. July 1958.

This analysis sets forth the annual adjustments required to develop a beef cattle-grain farm from a representative cotton farm in the Piedmont area. The beef cattle-grain farm would permit more complete and profitable use of the farm resources than does the cotton farm. Beginning with a farm of 132 acres, with 74 acres of cropland, 29 acres, with 20 in cropland, are added. The completed adjustment to the beef cattle-grain farm, with annual farm income at \$3,700 as opposed to less than \$600 and return to the operators for labor and management at \$2,100 as opposed to less than \$190 for the cotton farm would be a profitable alternative. Some other enterprise, dairying, for instance, might yield a more profitable return to the operator. Other systems may be better adapted to a particular area or to individual farm operators.

Along with the reorganization of the farming system, factors important in successful adjustment are changes in production practices and methods that will result in higher yields and more efficient production. Sound financial arrangements are necessary.

S. C. Agr. Expt. Sta., Clemson, S. C.

Atkins, S. W. CHANGING SIZE OF FARMS IN TENNESSEE. U. Tenn. Agr. Expt. Sta. B. 299. August 1959.

Tennessee farms on the average are becoming larger after declining in size for almost a century. The upturn began after the mid-30's, when a low of 70 acres per farm was reached following a steady decline from 260 acres in 1850. By 1954, the average farm had expanded to 86 acres, almost a fourth larger than the low level of the 1930's.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Helfinstine, R. D. STATISTICAL SUPPLEMENT. S. Dak. Agr. Expt. Sta., Agr. Econ. Dept. Agr. Econ. Pam. 67. November 1955. (Prod. Eco. Res. Br., Agr. Res. Serv.)

The Oahe Dam area, one of the Missouri Basin projects in central South Dakota, will make water available for irrigation. The study reported here compares prospective opportunities for dryland and irrigated farming in the area by means of farm budgets using a projected level of prices. Three typical sizes of farms--320, 480, and 800 acres--as well as a 160-acre farm, were used as examples. Land in the area is 63.7 percent irrigable. Budgets for the 800-acre and 480-acre dryland farms indicate that the cattle-hog and sheep-hog organizations would be about equally profitable. For the large, partially irrigated farm, the most profitable combination would be to use range pasture for a beef breeding herd, to fatten home-raised and purchased feeders on irrigated pasture, and to grow 40 acres of potatoes on irrigated land. For the 320-acre dryland farm, a dairy-hog combination would be most profitable. For a partially irrigated farm of this size, a sheep-hog combination with 40 acres of potatoes included would be most profitable. Investments under irrigated farming would need to be increased considerably. To shift from dryland to irrigated agriculture, farmers would need to acquire increased managerial skills and a knowledge of the techniques of irrigation.

S. Dak. Agr. Expt. Sta., College Station, S. Dak.

Davis, I. F., Jr., and Metzler, W. H. SUGAR BEET LABOR IN NORTHERN COLORADO. Colo. Agr. Expt. Sta. Tech. B. 63. 102 pp., illus. September 1958.

Mechanization of harvesting of sugar beets has increased the problem of obtaining hand labor for spring work in the beet fields. Domestic workers have been drawn to more attractive year-round jobs thus forcing beet growers to depend more on migrant workers. Interviews with 318 sugar beet farmers and 94 labor crew leaders in 1955 provided data for a review of the beet labor problem. With larger farms and increasing costs for hand

labor, beet producers are turning to mechanization as a substitute for labor. Further progress toward mechanizing fully the sugar beet thinning operation will depend upon advancement of such modern techniques as development of single germ varieties, uniform planting methods, and selective weed-control measures.

Colo. Agr. Expt. Sta., Fort Collins, Colo.

Bondurant, J. H., and Hole, E. TOBACCO GROWERS' COSTS AND RETURNS IN KENTUCKY BY TYPE OF TOBACCO AND LOCATION. Ky. Agr. Expt. Sta. B. 661, 104 pp., illus. June 1958.

The study reported was based on an economic analysis of production costs, receipts and returns to family labor, land, operating capital and management for 5 types of tobacco including 14 production areas. Information was obtained from 555 tobacco growers and a number of businessmen in 29 selected counties in 1951-53. The period was a stable one so far as costs and returns to tobacco farmers were concerned.

For the burley tobacco, production costs exclusive of family labor, management, land, and investment averaged \$265 per acre for the nine areas studied. Receipts averaged \$840 per acre and returns to labor, land, management, and investment \$575. Production averaged 1,598 pounds.

Production costs for fire-cured tobacco averaged \$145 per acre for the two areas studied; receipts \$449; and returns to labor, land, management and investment \$304.

Costs of production for dark air-cured tobacco averaged \$166 per acre for the three production areas studied; receipts \$469; and returns to labor, land, management and investment \$303.

The amount of labor used varied among the different types of tobacco, averaging 409 hours for burley, 356 for fire-cured, and 327 for dark air-cured.

Ky. Agr. Expt. Sta., Lexington, Ky.

Rogers, R. O., and Stucky, H. R. COTTON HARVESTING. A COMPARISON OF MACHINE VS. HANDPICKING IN ELEPHANT BUTTE DISTRICT, NEW MEXICO, 1957. N. Mex. Agr. Expt. Sta. Res. Rpt. 17, 30 pp., illus. August 1958.

Picking cotton with machines is cheaper than with hand labor when machines are fully used and when rates of performance per hour are fairly high. In the Elephant Butte Irrigation District in New Mexico in 1957 use of one-row pickers cost the same as handpicking of upland cotton, when the machine was used 200 hours per season and when at least 490 pounds of seed cotton were picked per hour. Comparable costs on long staple cotton were obtained when the one-row picker was used 160 hours at 350 pounds per hour. Two-row pickers used at the rate of 250 hours at 756 pounds per hour on upland cotton and 165 hours at 525 pounds per hour on long staple cotton cost the same as handpicking. Performance rates of the machines greater than these, per season or per hour, made machine picking cheaper than handpicking. Performance rates less than these made handpicking cheaper. Handpicking cost \$42 per bale for upland cotton in 1957. Machine picking cost \$39 per bale when the one-row machine was used 250 hours and picked at the rate of 490 pounds of seed cotton per hour. These results were obtained from a study of about 100 cotton growers in the district, some of whom used mechanical harvesters while others used hand labor for harvesting. Cotton farmers have increased their use of harvesting machines with the growing scarcity and increased costs of labor.

N. Mex. Agr. Expt. Sta., State College, N. Mex.

McCauley, Robert S., Analytical Statistician, Agr. Est. Div. Agr. Marketing Serv. HARVESTING THE 1956 CORN CROP. U. S. Agr. Res. Serv. ARS 43-91, 20 pp. 1959.

The total acreage of corn harvested in 1956 amounted to 75.6 million acres, of which 86 percent was for grain, 9 percent for silage, 4 percent for hogging and grazing, and about 1 percent for feeding without removing the ears. In 1956, the acreage was

relatively small, but yields were so good that the 54.3 million tons of silage attained a new production record and the 3,090-million-bushel crop of grain was the largest since the record crop of 1948.

In 1938, 12 percent and in 1956, 78 percent of the acreage of corn for grain was picked with mechanical pickers.

Numerous Charts.

FERD, ARS, USDA, Washington 25, D. C.

Davis, Velmar W. TRENDS, COSTS, AND MANAGEMENT IMPLICATIONS OF STORING HIGH-MOISTURE SHELLED CORN. Farm Econ. Res. Div. ARS, U. S. Dept. Agr., U. Ill. Col. of Agr. AE-3450, 12 pp. 1959.

The interest in storing high-moisture shelled corn began with the introduction of the field sheller and the advent of the airtight silo. More recently the discovery that high-moisture shelled corn could be stored satisfactorily in conventional silos, the demand for automation in the feedlot, and finally the favorable economics of the practice for relatively large-volume livestock feeders have spurred the building of new structures in which to store high-moisture corn.

Three types of structures are now used on corn-belt farms to store high-moisture shelled corn: (1) airtight bins, including glass-lined and galvanized steel grain bins; (2) conventional upright silos, made of poured concrete and concrete or tile staves; and (3) metal bins with plastic bag or liner.

Costs represent a major factor in choosing a structure or a method of harvesting and storing corn, but the advantages and disadvantages also should be considered. Important advantages of the high-moisture method include lower field losses, no drying costs, more rapid harvest, and adaptability to mechanized livestock feeding. Some limitations of this method are that the corn cannot be sold through normal market channels; it tends to bridge and does not feed down in bins that unload from the bottom; it is not suited for self-feeding in warm weather because it will heat and spoil; and, to prevent spoilage in silos that unload from the top, three or four inches of corn must be removed daily.

U. Ill. Col. of Agr., Urbana, Ill.

Davis, V. W., Arsdall, R. N., and Wills, J. H. MANAGEMENT AND COSTS OF FIELD-SHELLING AND ARTIFICIAL DRYING OF CORN IN ILLINOIS. B. 638, 72 pp. 1959.

Field-shelling, artificial drying, and farm storage of shelled corn were studied on 77 Illinois farms during the 1954 and 1955 harvesting seasons. Six additional farms on which high-moisture corn was field-shelled and stored in airtight bins were included. The complete harvesting process was studied from the viewpoint of integration into the farm business and to determine the economic and managerial implications of the change in harvesting method.

The principal reasons farmers gave for making the shift to shelled-corn methods were shortage of storage space and cheaper storage for shelled corn, easier work, and reduction of field losses.

Reduction of field losses through earlier harvesting and relatively low travel speed were the most significant economic effects of using field shellers.

From the standpoint of both management and costs, drying was the critical part of the harvesting operation.

A 2-man crew represented the most practical and efficient use of man-and-machine hours over the entire harvesting season.

Total field-shelling costs were highest for the picker-and-sheller at all volumes and least for the pull-type machine for volumes up to 18,000 bushels. Above this volume, the self-propelled machine was the most economical.

On the average, annual drying costs were about the same as field-shelling costs for comparable volumes. At 10,000 bushels' annual volume and 7 pounds of water removed per bushel, total drying costs per 100 bushels only varied from \$6.58 for the bin-type drier to \$7.12 for the column-type drier.

New storage for shelled corn included circular metal bins, masonry silos, arched-roof steel buildings, and an occasional wooden bin.

A comparison of field-shelling and drying and conventional picking and storing indicates that a farmer should handle a minimum of 7,000 to 7,500 bushels of corn annually before considering the shift in harvesting method. On a purely cash-grain and market basis, a farmer would need to dry 5,800 bushels of No. 2 corn at an average moisture content of 22 percent to save enough on market discounts to pay for the drying.

U. Ill., Urbana, Ill.

Powell, Albert E. IMPROVED OPERATING EFFICIENCIES INCREASE PORK PRODUCTION. *Agr. Engin.* 40: 274-277, 279-280. 1959.

This article describes a cooperative project near Ames, Iowa, in 1956 of Max Bailey, farmer, and the Douglas Fir Plywood Association.

The articles describe and illustrate the building used by Mr. Bailey for profitable, large scale production of market hogs.

During the pregestation and gestation periods the sows are held in the field. A few days before farrowing the sow is brought into a farrowing house where she remains until the pigs are weaned. The sow is then taken to her shelter in the field where she will remain until her next trip to the farrowing house. The pigs are weaned at from 3 to 5 weeks, after which they are transported by trailer to a growing building. With the farrowing house on a schedule of being filled once every six weeks, this leaves approximately one week for cleaning the house for the next cycle. The pigs are kept in the growing building from 3 to 5 weeks. When they are about 8 weeks old and weigh from 40 to 50 lbs. they are transferred by trailer to a finishing building. This puts the growing building on a schedule of being filled every six weeks, allowing one week for cleaning. Although this timing requires only one growing building, two growing buildings are used in order to provide a rest period for each building between uses. Each growing building rests for six weeks between uses. This was done to facilitate disease control. The hogs are kept in the finishing building from 12 to 16 weeks or until reaching a market weight of from 200 to 225 lb. at from 5 to 6 months of age.

The author concludes that the cooperative project has been successful in achieving its objectives. It has demonstrated that it is possible and economically feasible to produce pork in a full confinement system at a profit.

Douglas Fir Plywood Assoc., Tacoma, Wash.

Hughes, W. F., Keating, F. E., Jones, J. H., and Moldenhauer, W. C. ECONOMIC RETURNS FROM GRAIN SORGHUM FED TO STEER CALVES ON DRYLAND FARMS OF THE HIGH PLAINS. *Tex. Agr. Expt. Sta. MP-295*, 15 pp., illus. August 1958.

Livestock feeding is an alternative market for grain and forage sorghum produced on dryland farms of the High Plains. Most of these farms have facilities that would be adequate for livestock feeding purposes. An additional investment of about \$6,300 would be required to provide facilities for feeding 100 head of steer calves. The annual cost of these added facilities would be about \$850. Feed required per steer for a 180-day period would include 1,900 pounds of sorghum grain, 360 pounds of cottonseed meal and 2,400 pounds (net) of silage. From these quantities of feed, farmers could expect an average daily gain of 2 pounds, or 360 pounds of gain, market weight basis, per steer during the 180 days. At average yields, a total of 220 acres of cropland would be needed to provide the grain and silage required for 100 steers. Each 25-cent increase in the price per 100 pounds of grain sorghum would raise the cost per pound of gain by 1.57 cents. A \$10 per ton increase in the price of cottonseed meal would cause a half-cent rise in the cost per pound of gain. The total cost per pound of gain, exclusive of labor-management costs, would increase 0.04 cent with each 1-cent increase in the initial cost of steers. The

selling price required to break even, labor-management costs excepted, would be affected by the initial price of the steers and by the price of sorghum grain and cottonseed meal. The break-even price would be raised by 0.70 cent per pound by each 25-cent increase in the price of grain sorghum and by 0.23 cent per pound by each \$10 per ton increase in the price of cottonseed meal. On a 150-day feeding enterprise with comparable feed prices, the total cost per pound of gain, labor-management costs excepted, would be slightly higher, regardless of the level of feed prices.

Tex. Agr. Expt. Sta., College Station, Tex.

Hansing, Frank D. BROILER COSTS AND RETURNS IN LOWER DELAWARE, 1952-55
Del. Agr. Expt. Sta. B. 327, 30 pp., illus. February 1959.

To obtain good returns from broilers, a low mortality rate is required. Size of flock influences very little returns from flocks that contain less than 20,000 birds. Feed conversion is closely related to the percentage of mortality. The effect of mortality on feed conversion depends on the age of the birds at death. The cost per pound of broilers sold and the ratio of feed conversion are directly related. For Delaware flocks containing 20,000 or more, the average selling price was slightly lower and the average cost slightly higher than for smaller flocks. Returns increased for flocks sold at ages up to 10 weeks, and decreased for each week thereafter. For each week above 10 that the birds were kept on the farm, the rise in cost averaged about 1 cent per pound. Average weight also influences flock returns. The highest return per thousand was received from flocks sold at weights ranging from 2 3/4 to 3 1/4 pounds. Summer flocks returned more than three times as much per thousand as did winter flocks--summer flocks can be produced at a 2-cent lower cost per pound than winter flocks; the mortality rate is nearly a third lower in summer than in winter, and the selling price of summer flocks averages almost 1 cent per pound higher than that of winter flocks. Independent growers produced their flocks at a lower average direct cost and sold them at a slightly higher price than did growers producing under share and guarantee contracts. Cost of production averaged slightly above 1 cent per pound more under the share than under the guarantee contract. This may have been partly because servicemen for feed companies watched the guarantee flocks more closely. Losses were connected with nearly one-fourth of the flocks. These conclusions were arrived at from a study of records for about 2,900 flocks, containing about 25 million broilers sold between mid-1952 and mid-1955.

U. Del., Newark, Del.

Jennings, R. D. CONSUMPTION OF FEED BY LIVESTOCK, 1909-56. RELATION BETWEEN FEED, LIVESTOCK, AND FOOD AT THE NATIONAL LEVEL. U. S. Dept. Agr. Prod. Res. Rpt. 21, 128 pp., illus. November 1958.

This report revises and continues the series of data on feed consumption by livestock presented in two earlier reports under the same general title--Circular 836, published by the Department of Agriculture in 1949, superseding Circular 670 published in 1943. The estimates show that the percentage of all feed units coming from hay has increased and those from pasture have decreased. Total live weight production of meat animals and production of livestock products have increased more than animal numbers. Grain-consuming animal units of livestock increased from 128 million in 1909 to 166 million in 1956. The number of roughage-consuming animal units increased by a lesser amount. Feed inputs per head of livestock have increased over the years, but inputs per unit of livestock production have decreased. Less than half the total feed nutrients consumed by livestock in the United States could be used for human food.

Inform. Div., ARS, USDA, Washington 25, D. C.

Plastic-covered buildings have been used successfully as sheep shelters at the University of California's Hopland Field Station in northern California. Such buildings can be built at a cost of 7 to 10 cents per square foot of floor space.

The plastic film will last longer if the following rules are observed:

Buildings should be located where tree branches cannot fall and puncture the film.

Poles must be firmly anchored to prevent the wind from pulling the shelter from the ground.

Framework and nailing strips should have rounded, smooth edges to avoid puncturing the film.

Adhesive should be applied wherever the film touches the framework.

Film should be stretched taut if applied on cold days, loosely if applied on warm days.

Film should be applied on a still day, for it is very difficult to handle if a breeze is blowing.

Animal Husbandry, U. Calif., Davis, Calif.

Economics of Conservation

Coutu, Arthur J., McPherson, W. W., and Martin, Lee R. METHODS FOR ECONOMIC EVALUATION OF SOIL CONSERVATION PRACTICES. N. C. Agr. Expt. Sta. Tech. B. 137, 48 pp., illus. January 1959.

Three mechanical erosion-control practices were considered: (1) A complete terracing program with contour cultivation and recommended runoffs and waterways; (2) terracing and meadow outlets without contour cultivation; and (3) complete terracing with contour cultivation and strip cropping. Crops analyzed were tobacco and cotton. Physical resource requirements for each of three practices were estimated. Model fields representing conditions most commonly found in the Upper Coastal Plain and Lower Piedmont of North Carolina were established. Costs of resources required were based on 1947-50 averages, except labor, for which 1952 prices were used. For a 10-acre tobacco field requiring approximately 1 mile of terraces, costs were estimated as follows:

Item	Practice		
	I	II	III
Establishment.....	Dollars 230	Dollars 120	Dollars 160
Annual Maintenance.....	62	18	37
Annual operational inputs.....	12	4	9
Total.....	304	142	206

Two sets of yield differences were derived by informal procedures from production records on sample fields. Because of uncertainty regarding the accuracy of the estimates of actual yield differences, analytical procedures were developed for estimating the amount that yield differences must reach for Practice I to be profitable for cotton and for tobacco. Average prices of the row crops during the period 1947-50 were used to estimate the effect on income of each of the practices studied. Using a procedure for compounding costs and revenues to take account of differences in time periods and in alternative discount rates, it was found that practice II would be most profitable for

either crop. Using a discounting process that produced results comparable to the first technique, but made possible an examination of the interrelationships among the variables, permitted analysis of more combinations of specific conditions. This technique made it possible to determine the amount of subsidy needed to make it profitable for the individual to take actions consistent with the public interest.

The study covered five counties.

N. C. Agr. Expt. Sta. Raleigh, N. C.

Boykin, C. C., Jr. EVALUATION OF CONSERVATION PERFORMANCE. J. Soil and Water Conserv. 14: 12-15. 1959.

A method for evaluating conservation performance of soil conservation district co-operators was developed by the Texas Agricultural Experiment Station during 1955-1956 in a study of obstacles to the application of soil and water conservation practices on tenant-operated farms. Landowners and tenants of the 26 farms studied were cooperating with the Navarro-Hill Soil Conservation District and were receiving technical assistance from the Soil Conservation Service work unit at Corsicana. Although tenant-operated farms have declined from over 70 per cent in 1930 to about 40 per cent in 1954, tenure-associated problems in achieving progress in the application of needed soil and water conservation practices still exist.

The purpose of this paper is to explain how the conservation performance rating system was developed; how it was used in the study of tenant-operated farms under agreement with the District; and how it may be used in identifying other problems relating to progress in the application of a soil and water conservation program.

Tex. Agr. Expt. Sta., Texas A&M Col., College Station, Tex.

Farm Econ. Res. Div., ARS. WATERSHED PROGRAM EVALUATION, KIOWA CREEK, COLORADO - INTERIM PROGRESS REPORT. U. S. Agr. Res. Serv. ARS 43-97. 26 pp. 1959.

The Kiowa Creek watershed is a foothill area with steep slopes in which cloudbursts are common. The interest and determination of farmers and ranchers and their cooperation with the Kiowa Soil Conservation District resulted in the establishment of the Kiowa Creek Watershed Protection Project in 1954. The work plan of the project included a supplement for program evaluation.

The purposes of the evaluation program are to estimate and measure:

- (1) Soil and water conservation benefits;
- (2) Benefits from reduced damage by floodwater and sediment; and
- (3) Benefits from increased crop yields resulting from the more intensive use of flood-plain land associated with flood prevention.

Agencies participating in the evaluation program are the Weather Bureau, Geological Survey, Agricultural Research Service, and Soil Conservation Service. The physical effects and monetary values of soil and water conservation and floodwater and sediment control are being measured, studied, and interpreted. In accord with the evaluation plan, measuring devices to record streamflow, sedimentation, and precipitation, and for study of selected floodwater-retarding reservoirs had been installed by the end of 1956. A study of the economic effects of the project is underway.

Inform. Div., ARS, USDA, Washington 25, D. C.

BIOLOGY-WILDLIFE

Allen, Durward L. TOO GREEN THE GRASS. J. Soil and Water Conserv. 13: 113-116. 1958.

We must bring the time element into resource use and consider realistically the development of a habitat for man in North America. It's an ecological problem involving

quantities of natural wealth, cultural level, numbers of people, and the living standard we require. In that standard, certain welfare factors must be identified now, or generations to come will find the decisions made and values pre-empted.

Purdue U., Lafayette, Ind.

Stoddard, Charles H. DISTRICTS, FORESTRY, AND WILDLIFE MANAGEMENT. J. Soil and Water Conserv. 13: 117-120. 1958.

Generally speaking the application of forestry practices and wildlife habitat management has not been applied by land-owners with the same vigor as have other soil and water conservation measures. Neither of these problems has yielded to educational or technical assistance programs except to a very limited degree. Nor have they been integrated with soil conservation districts to the extent possible--partly because of differences in approaches to application by forestry and wildlife agencies. Since much of the success in applied soil and water conservation is attributed to the soil conservation districts, it is suggested that an experimental program for gearing forestry and wildlife programs into the district approach be tried. Means are suggested whereby the districts might provide more active supervision over forestry programs and develop cooperative wildlife programs with sportsmen's groups. Considerably more inter-agency cooperation and experimentation will be required for such programs than exists at present.

Resources for the Future, 1145 Nineteenth St., NW., Washington 6, D. C.

Cottam, Clarence. WILDLIFE AND WATER CONSERVATION. J. Soil and Water Conserv. 13: 65-69. 1958.

Good soil and water conservation is no less a prerequisite for sustained and successful agricultural crop yield than it is for wildlife production. Wildlife is a product of the land just as much as is corn, cotton or livestock.

Poor hunting and fishing are as characteristic of poor land as are the scanty agricultural crops produced. Wild animals abhor wornout, eroded and abandoned farm land because of inadequacy of food and cover and because the mineral fertility of food nutrients is too low to sustain them in health. Successful wildlife management must start with the soil.

Much progress has been made, and the Soil Conservation Service and local conservation groups deserve great credit for helping to improve wildlife habitat throughout the country by means of sound soil and water conservation practice. Sound wildlife, soil and water conservation programs are inseparable.

Illustrations.

Welder Wildlife Found., Sinton, Tex.

Stoeckeler, J. H., Keener, John M., and Strothmann, R. O. DEER BROWSE PRODUCTION FROM FELLED TREES IN THE NORTHERN HARDWOOD-HEMLOCK FOREST TYPE. J. Forestry 56: 416-421. 1958.

A study was made of the production of potential deer browse in newly felled trees in the northern hardwood-hemlock forest type in northeastern Wisconsin.

The study procedure consisted of clipping the previous season's growth on hardwoods and stripping the needles of hemlock.

On the basis of fresh browse yield per square foot of basal area (that is, cross-sectional area in square feet at breast height), the northern hardwoods such as sugar maple, red maple, yellow birch, basswood, and white ash in pole- and sawlog-size stands produced an average of about 13 pounds of fresh browse and hemlock 117 pounds per square foot of basal area.

The browse production per thousand board feet of gross volume of sawlogs cut amounted to 121 and 1,507 pounds for hardwoods and hemlock respectively.

Per standard 4x4x8-foot cord, the browse production for 5- to 9-inch-diameter classes inclusive was 80 and 929 pounds for hardwoods and hemlock respectively.

On the average Nicolet National Forest timber sale in northern hardwood-hemlock type, where only about 20 percent of the total basal area or volume on the stand is cut, comprising an average of 1,400 board feet per acre of which around 10 percent is hemlock, the browse produced per acre was calculated as about 360 pounds, fresh weight.

The total browse production in the 2,925 acres of this type cut on this forest in a recent sample year is estimated at 526 tons per year, theoretically equal to one-half the entire nutrient need of 5,850 deer for an 80-day winter period when the natural food supply is at a minimum.

In young hardwood stands of 1- to 5-inch-diameter class the amount of fresh browse per square foot of basal area ranges from 26.3 to 46.2 pounds.

In stands of larger diameter, hardwoods in the 10- to 20-inch diameter class provided 15.1 to 6.4 pounds of browse per square foot of basal area for sugar and red maples and 13.5 to 18.0 pounds for yellow birch, white ash, and basswood combined.

Sustained yield forestry with annual timber cutting on large forest properties is an important factor in the over-winter survival of the deer herd due to supplemental feed provided in the newly felled tops and later in the sprouts and new seedlings stimulated by logging.

Lake States Forest Expt. Sta., St. Paul 1, Minn.

Hutchinson, James A., and White, Morris. OWNER EXPERIENCES WITH FARM PONDS IN EAST-CENTRAL ALABAMA. Agr. Expt. Sta. of the Ala. Polytech. Inst. C. No. 129. 1959.

The 470 ponds in Lee County, located in east-central Alabama, contain about 2,200 surface acres of water. About 320 of them are private ponds and contain 1,640 surface acres, or 13,000 acre feet of water.

Government agencies rendered valuable assistance to pond owners in planning, constructing, and managing ponds. Eighty-six per cent of the sample pond owners received technical assistance from government agencies.

Per acre cost of constructing noncommercial ponds was inversely related to pond size, and ranged from a low of \$211 for large ponds to \$590 for small ponds. Ponds used for irrigation had the lowest average per acre cost of construction, \$203. Average per acre cost of construction of all sample ponds was \$268. None of the pond owners reported receiving financial aid for pond construction from government agencies.

Annual costs varied from a low of \$7.24 per surface acre for commercial ponds used for irrigation to \$30.81 for ponds used by clubs. Annual costs were about \$30 for 4 of the 6 groups of ponds. Groups for which average annual per surface acre costs were most different were large noncommercial ponds with costs of \$10.98 and irrigation ponds with costs of \$7.24.

Ponds rented to clubs returned a net income of \$75 per surface acre.

Net returns to owners who sold fishing permits averaged \$14.80 per surface acre when no charge was made for family labor involved in selling permits. When the prevailing wage rate was applied to the hours of family labor involved, these ponds showed a deficit in net returns.

The estimated net return per acre-inch of water applied to pastures, small grains, and silage was \$0.51, and for cotton, \$6.48.

Owners of small ponds reported an average catch of 192 pounds of fish in 290 hours of fishing per surface acre of pond. An average of the reports from owners of medium-size ponds showed 135 pounds of fish caught in 80 hours of fishing per surface acre.

Five of the 6 groups of ponds yielded profitable monetary returns to their owners.

Agr. Expt. Sta. of the Ala. Polytech. Inst., Auburn, Ala.

The history of field investigations of the effects of DDT on wildlife is reviewed briefly, from the initial studies in 1945 through the more recent studies of the effects of a large-scale program for spruce-budworm control and gypsy-moth eradication. DDT dosages and procedures that are recommended for protection of wildlife are reviewed. Effects of aldrin, heptachlor, and toxaphene are discussed in connection with the grasshopper and Mormon cricket control programs. Delayed and indirect effects of chemical treatments are emphasized as an important current problem. Cited in this connection are fish losses in the Yellowstone and Miramichi rivers and losses of wildlife from eating earthworms a year after treatment of the area with DDT. Currently recommended procedures to safeguard wildlife in pesticidal programs are listed.

U.S. Fish & Wildlife Serv., Patuxent Res. Refuge, Laurel, Md.

